FINAL
NO FURTHER ACTION DECISION UNDER CERCLA
STUDY AREA 61Z
BUILDING 202 HISTORIC MOTOR POOL

DEVENS RESERVE FORCES TRAINING AREA
DEVENS, MASSACHUSETTS

Prepared for:

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

Contract DACA31-94-D-0061

Prepared by:

Harding Lawson Associates
Portland, Maine
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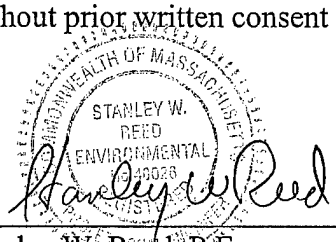

Stanley W. Reed, P.E.
Project Manager

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U.S. Army Corps of Engineers
New England District

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CONTRACT DACA31-94-D-0061
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EXECUTIVE SUMMARY

This decision document has been prepared to support a decision for no further action under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) for soil and groundwater at the Building 202 dry well, No. 2 Fuel Oil underground storage tank (UST), and waste oil UST at Study Area (SA) 61Z. SA 61Z is the site of an historic motor pool formerly located at the corner of Carey and St. Mihiel streets on the northeast portion of the Main Post at the Devens Reserve Forces Training Area (RFTA) (formerly Fort Devens), Devens, Massachusetts.

Fort Devens was identified for cessation of operations and closure under Public Law 101-510, the Defense Base Closure and Realignment Act of 1990, and was officially closed in September 1996. Portions of the property formerly occupied by Fort Devens were retained by the Army for reserve forces training and renamed the Devens Reserve Forces Training Area. Areas not retained as part of the Devens RFTA were, or are in the process of being, transferred to new owners for reuse and redevelopment. The Army plans to transfer ownership of property at SA 61Z to the Massachusetts Government Land Bank in late 1999 for commercial development.

SA 61Z was once the site of an historical motor pool located on the northeast portion of the Main Post at the Devens RFTA. The site is triangular in shape and is bounded on the east and northwest by St. Mihiel and Carey streets and on the southwest by former railroad tracks (Arthur D. Little [ADL], 1995). The main feature at the site was Building 202 which was built in 1941 and used until the early 1990s as a maintenance and motor repair shop. Several smaller sheds and warehouses were also associated with the motor pool. Liquid wastes generated during maintenance operations at Building 202 were discharged to a drain pit (3 by 5 by 2 feet), located in the northeast corner of Building 202, and subsequently to a dry well located between Building 202 and St. Mihiel Street. The dry well was removed along with approximately 200 cubic yards (cy) of petroleum-contaminated soil in March 1995, and Building 202 was demolished in July 1999. An unpaved parking lot southwest of the former location of Building 202 and west of the former railroad tracks is presently being used for the lined and covered temporary storage of contaminated soil removed from other sites at Devens RFTA.

Building 202 was also the site of a 1,000-gallon waste oil underground storage tank (UST) and a 5,000-gallon No. 2 Fuel Oil UST. The waste oil UST, located along the southeast wall of Building 202, was put in service in 1942. Environmental contamination associated with the waste oil UST was investigated as SA 48. The UST was removed

along with approximately 100 cy of soil in February 1989. Additional soil removal occurred in 1993. Subsequent sampling and a human-health Preliminary Risk Evaluation indicated that residual contamination at SA 48 did not pose a risk to human health. A No Further Action Decision Document for SA 48 was completed and signed in 1995.

The No. 2 Fuel Oil UST, located adjacent to the northeast wall of Building 202, was removed in 1996. Screening samples collected from the excavation bottom at approximately 11 feet below ground surface (bgs) and sidewalls prior to backfilling showed total petroleum hydrocarbon (TPH) concentrations of less than 25 parts per million.

Environmental investigations at SA 61Z have included surface-soil sampling in the unpaved parking lot southwest of Building 202 and east of the former railroad tracks, subsurface-soil sampling in the vicinity of the dry well, and groundwater sampling downgradient of the dry well. This sampling has shown that portions of the unpaved parking lot surface are contaminated with carcinogenic polynuclear aromatic hydrocarbons at concentrations of potential concern (ADL, 1995).

Subsurface-soil sampling in the vicinity of the dry well has shown that the dry well removal activities successfully removed petroleum contaminated soil exceeding the Massachusetts Department of Environmental Protection (MADEP) action limit of 500 milligrams per kilogram of TPH to a depth of 15 feet bgs. Concentrations of residual petroleum contamination, measured as TPH, in soil deeper than 15 feet decrease to 248 ppm at 23.5 feet bgs.

Groundwater samples collected in August 1996 showed petroleum contamination of up to 6,550 micrograms per liter (µg/L) existed in shallow groundwater downgradient of the former dry well location. Samples collected in November 1996 showed only low concentrations (21 µg/L) of the volatile fraction of TPH and indicated that groundwater quality had improved significantly. This is attributed to removal of the dry well that was the interpreted contaminant source, to attenuation of fuel compounds in groundwater by sorption and biological degradation, and dispersion and dilution. Volatile and semivolatile organic compounds included as target analytes in the Extractable and Volatile Petroleum Hydrocarbon (EPH/VPH) methodology were not detected in the groundwater samples.

As part of the site investigation at SA 61Z, a baseline human-health risk characterization based on the Massachusetts Contingency Plan Method 3 approach was performed to evaluate potential risks associated with potential commercial/industrial exposure to

groundwater contaminated with EPH/VPH fractions of TPH at SA 61Z. The estimated noncarcinogenic risks did not exceed a cumulative Hazard Index of 1. Because the EPH/VPH fractions are not established as carcinogenic, no cancer risk was identified. Further, state and federal drinking water standards were not exceeded, and no risk to public welfare was identified. An environmental risk assessment was not performed, because ecological receptors are not likely to be exposed to site groundwater. In summary, the SI risk evaluation demonstrated that no significant risk associated with commercial/industrial or ecological exposure to groundwater exists at the site.

A waste oil UST, located adjacent to the southeast wall of Building 202, was removed in 1999. Confirmation samples collected from the excavation sidewalls and bottom prior to backfilling showed total EPH/VPH concentrations of 45 parts per million or less.

A separate preliminary human health risk evaluation was performed during preparation of the decision document to assess potential risks associated with residential exposure to subsurface soil and groundwater at SA 61Z. The risk evaluation concluded that subsurface soil and groundwater at SA 61Z do not pose a significant health threat based on a potential residential use scenario. SA 61Z is suitable for unrestricted future use.

Because only limited contamination was identified at the site and to accelerate the transfer of property, the status of SA 61Z was administratively changed from an Area of Contamination (AOC) to a Study Area in January 1998, as set forth in a Consensus Statement between the U.S. Army, U.S. Environmental Protection Agency (USEPA), and MADEP.

Upon consideration of the completed dry well, No. 2 Fuel Oil UST, waste oil UST removal actions; and the outcome of the groundwater and subsurface-soil risk evaluations; the site does not present a an unacceptable threat to human health under the evaluated residential use scenario, or to the environment. No further action is recommended for groundwater and soil at the dry well, No. 2 Fuel Oil UST, and waste oil UST at SA 61Z.

Further evaluation of surface soil in the Building 202 unpaved parking lot component of SA 61Z is administratively transferred to the Soil Storage Facility Closeout activities and will be addressed upon removal of the contaminated soil stockpiles.

Signature of this decision document by the U.S. Army, U.S. Environmental Protection Agency, and Massachusetts Department of Environmental Protection will remove SA 61Z from further consideration under the U.S. Army Installation Restoration Program

and CERCLA. In addition, further evaluation of surface soil in the former Building 202 unpaved parking lot will be addressed as part of Devens Soil Storage Facility Closeout activities. No further response action will be required of the Army at SA 61Z.

1.0 INTRODUCTION

This decision document was prepared to support a decision for no further action under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) for soil and groundwater at the Building 202 dry well, No. 2 Fuel Oil underground storage tank (UST), and waste oil UST at Study Area (SA) 61Z at the Devens Reserve Forces Training Area (RFTA, formerly Fort Devens), Devens, Massachusetts. In addition, it administratively transfers evaluation of surface soil in the SA 61Z unpaved parking lot adjacent to Building 202 to Devens Soil Storage Facility Closeout activities. It was prepared by Harding Lawson Associates (HLA) as a component of Task Order 007 of Contract DACA31-94-D-0061 under the direction of the U.S. Army Corps of Engineers (USACE), New England District.

Fort Devens was identified for cessation of operations and closure under Public Law 101-510, the Defense Base Closure and Realignment (BRAC) Act of 1990, and officially closed in September 1996. Portions of the property formerly occupied by Fort Devens were retained by the Army for reserve forces training and renamed the Devens Reserve Forces Training Area. Areas not retained as part of the Devens RFTA were, or are in the process of being, transferred to new owners for reuse and redevelopment. SA 61Z is located within an area planned for transfer to the Massachusetts Government Land Bank in late 1999 for commercial development.

Fort Devens was placed on the National Priorities List on December 21, 1989, under CERCLA as amended by the Superfund Amendments and Reauthorization Act (SARA). In conjunction with the U.S. Army Installation Restoration Program, the U.S. Army Environmental Center (USAEC) developed a Master Environmental Plan (MEP) for Fort Devens in 1992 (Biang, et al., 1992). The MEP consisted of assessments of the environmental status of study areas, specified necessary investigations, and provided recommendations for response actions with the objective of identifying priorities for environmental restoration at Fort Devens. Areas Requiring Environmental Evaluation (AREEs) and SAs were identified, and investigations were initiated to determine where removal actions were necessary.

SA 61Z is the site of an historical motor pool at the corner of Carey and St. Mihiel streets on the northeast portion of the Main Post at the Devens RFTA. The main feature at the site was Building 202, which was used until the early 1990s as a maintenance and motor repair shop. Building 202 was demolished in July 1999; however, it was present when SA 61Z investigations were performed, and, consequently, much of this decision document is

worded as if the building were still in place. Liquid wastes generated during maintenance operations at Building 202 were discharged to a drain pit, located in the northeast corner of Building 202, and subsequently to a dry well located between Building 202 and St. Mihiel Street.

The Army initiated remedial investigation (RI) field activities at SA 61Z, then designated Area of Contamination (AOC) 61Z, in June 1996. However, because only limited contamination was identified at AOC 61Z and to accelerate the transfer of property, the status of SA 61Z was administratively changed from an AOC to a SA as set forth in a January 1998 Consensus Statement between the U.S. Army, U.S. Environmental Protection Agency (USEPA), and Massachusetts Department of Environmental Protection (MADEP) (Appendix A).

2.0 BACKGROUND AND PHYSICAL SETTING

The following subsections provide a brief description of the history and physical setting of Devens RFTA and of SA 61Z. More detailed descriptions are available in the reports associated with previous activities and investigations discussed in Section 3.0.

2.1 DEVENS RESERVE FORCES TRAINING AREA BACKGROUND

The Devens RFTA is located within the towns of Ayer and Shirley (Middlesex County) and Harvard and Lancaster (Worcester County), approximately 35 miles northwest of Boston, Massachusetts (Figure 2-1). It was created in 1996, coincident with the closure of Fort Devens, to provide facilities for the training of reserve forces in central New England. The Devens RFTA includes portions of the former North Post and Main Post, and the entire South Post. It lies within the Ayer, Shirley, and Clinton map quadrangles (7½-minute series).

Fort Devens was established in 1917 as Camp Devens, a temporary training camp for soldiers from the New England area. In 1931, the camp became a permanent installation and was redesignated as Fort Devens. Throughout its history, Fort Devens served as a training and induction center for military personnel and a unit mobilization and demobilization site. All or portions of this function occurred during World Wars I and II, the Korean and Vietnam conflicts, and operations Desert Shield and Desert Storm.

Over 3,000 acres at Fort Devens were developed for housing, buildings, and other facilities; and the installation was reported as the largest undeveloped land holding under a single owner in north-central Massachusetts (U.S. Fish and Wildlife Service [USFWS], 1992). The North Post consisted primarily of the Moore Army Airfield and the site of the installation's wastewater treatment facility. The Main Post was the site of numerous buildings, including tracked and vehicle maintenance facilities, training and administrative buildings, barracks and other military housing, and recreational facilities. The South Post, largely undeveloped, is located south of Massachusetts Route 2 and was used for field training exercises.

In 1985, Fort Devens applied for a Resource Conservation and Recovery Act (RCRA) Part B Permit for its hazardous waste storage facility, and in 1986 USEPA issued a final permit that included a list of Solid Waste Management Units requiring corrective action. In December 1989, Fort Devens was placed on the National Priorities List. A Federal

Facility Agreement between the U.S. Army and the USEPA established the Army as the lead agency under CERCLA for cleanup of Fort Devens (USEPA, 1991b).

Fort Devens was identified for cessation of operations and closure under Public Law 101-510, the BRAC Act of 1990, and was officially closed in September 1996. Portions of the property formerly occupied by Fort Devens were retained by the Army for reserve forces training and renamed the Devens RFTA. Areas not retained as part of the Devens RFTA were, or are in the process of being, transferred to new owners for reuse and redevelopment. SA 61Z is among the areas designated for commercial/industrial development in the Devens Reuse Plan (Vanasse Hangen Brustlin, Inc., 1994).

2.2 Regional Geology

The Devens RFTA is near the western boundary of the Seaboard Lowland Section of the New England-Maritime Physiographic province (Jahns, 1953). It is adjacent to the Worcester County Plateau of the Central Uplands province and lies partly within the province (Koteff, 1966). The land surface is almost completely covered with unconsolidated glacial outwash deposits, resulting in few bedrock outcrops. The surficial deposits are underlain by a highly complex assemblage of intensely folded and faulted metasedimentary rocks with occasional igneous intrusions. The geomorphology of the region is dominated by glacial features such as outwash plains, kames, kame terraces, drumlins, and eskers.

2.3 Regional Hydrogeology

Groundwater at the Devens RFTA occurs largely in the permeable glacial-deltaic outwash deposits of sand, gravel, and boulders. Well yields within these sediments are dependent upon the hydraulic characteristics of the aquifer and can range from 2 to over 300 gallons per minute. Small amounts of groundwater can be obtained from fractured bedrock with yields ranging from 2 to 10 gallons per minute. Minor amounts of groundwater may be found in thin, permeable glacial lenses elsewhere on the installation. The primary hydrogeologic feature at Devens RFTA is the Nashua River, which flows through the facility in a south to north direction, with an average discharge rate of 55 cubic feet per second. In addition to the Nashua River, the terrain is dissected by numerous brooks and attendant wetlands. There are also several kettle ponds and one kettle lake.

2.4 STUDY AREA DESCRIPTION AND HISTORY

SA 61Z is the site of a historical motor pool located on the northeast portion of the Main Post at the Devens RFTA (Figure 2-2). The site is triangular in shape and is bounded on the east and northwest by St. Mihiel and Carey streets and on the southwest by former railroad tracks (ADL, 1995). The main feature at the site was Building 202 which was built in 1941 and used until the early 1990s as a maintenance and motor repair shop. Building 202 was demolished in July 1999 in preparation for property transfer. Several small sheds and warehouses were also associated with the motor pool (ADL, 1995). Liquid wastes generated during maintenance operations at Building 202 were discharged to a drain pit (3 by 5 by 2 feet), located in the northeast corner of Building 202, and subsequently to a dry well located between Building 202 and St. Mihiel Street. As described in detail in Subsection 3.6, the dry well was removed along with approximately 200 cubic yards (cy) of petroleum-contaminated soil in March 1995.

Building 202 was also the site of a 1,000-gallon waste oil underground storage tank (UST) and a 5,000-gallon No. 2 Fuel Oil UST. The waste oil UST, located along the southeast wall of Building 202, was put in service in 1942 and was removed along with approximately 100 cy of soil in February 1989. Additional soil removal occurred in 1993. The waste oil UST was investigated at SA 48 as discussed in greater detail in Subsections 3.1 through 3.4.

The fuel oil UST, located adjacent to the northeast wall of Building 202, was removed in 1996, as discussed in greater detail in Subsection 3.6.

A gravel surface parking lot presently exists at SA 61Z between Building 202 and the former railroad siding. The parking lot and Building 202 are enclosed by a fence with a gate on the western side. The former dry well was located outside the fenced area. In the Devens Reuse Plan (Vanasse Hangen Brustlin, Inc., 1994), the site is designated for future rail, industrial, and trade-related uses (e.g., office buildings, light industry, and academic and institutional uses).

3.0 PREVIOUS ACTIVITIES AND INVESTIGATIONS

The following subsections discuss environmental investigations and removal actions performed by Army contractors at SA 48 and SA 61Z. At SA 48, a Tank Removal Action, a Site Investigation (SI), a Soil Removal Action, and a supplemental SI (SSI) were performed between 1989 and 1994. Investigation activities at SA 61Z began in 1994 with a supplemental site evaluation (SSE), which was followed by the dry well Removal Action in 1995, and the fuel oil UST Removal Action and RI field activities in 1996. A waste oil UST was removed from the site in 1999. The scope of previous investigation activities performed at SA 48 and SA 61Z is summarized in Tables 3-1 and 3-2.

3.1 FEBRUARY 1989 WASTE OIL UST REMOVAL

The waste oil UST at Building 202 was used to store waste oil from vehicle servicing performed inside the building. Tank removal observations were documented in a report prepared by Environmental Engineering and Geotechnics, Inc. (EE&G, 1989). Highlights of this removal effort are summarized below.

Three hundred gallons of product and approximately 80 gallons of sediment sludge were removed from the UST prior to its excavation. Contaminated soil, possibly resulting from a seam separation in the UST, was discovered on the excavation walls. Screening of the contaminated soil with a photoionization detector (PID) yielded total organic vapor (TOV) concentrations between 8.8 and 45.3 parts per million (ppm). Approximately 100 cy of waste oil contaminated soil (TOV greater than 10 ppm) were removed from the tank excavation. Stockpiled soil was removed from the site by Enpro Services, Inc., of Newburyport, Massachusetts, and disposed of at the Consolidated Waste Services Facility in Norridgewock, Maine, under a hazardous waste manifest.

Nineteen samples of residual soil collected from the bottom and sides of the excavation were field screened for TOVs using a PID. PID readings ranged from 0.0 to 10 ppm. While the excavation was open, two rounds of confirmatory sampling with laboratory analysis were performed. During the first round, a composite soil sample was collected from the bottom of the tank excavation and submitted to LCC Institute of Water Research, Lubbock, Texas, for analysis for total petroleum hydrocarbons (TPH). Results of the first round analysis indicated the presence of TPH at 916 ppm, which exceeded the "limiting criteria of 50 ppm". Soils exceeding the limiting criteria required corrective measures, as reported in the Tank Removal Monitoring Report. An additional composite

sample was collected and submitted for TPH analysis to confirm the presence of TPH. TPH was detected at a concentration of 3,210 ppm in this second sample. The excavation was lined with plastic sheeting and backfilled.

In May 1989, EE&G advanced two soil borings (B-3 and B-4) to 32 feet below ground surface (bgs) near the former UST location (Figure 3-1). Observed geologic materials consisted of sand, gravely sand, and silty sand. The water table was encountered at 29 feet bgs. Soil samples were collected at 5-foot intervals to a depth of 10 feet, and continuously from 10 feet to the bottom of the borings. TOV screening concentrations were less than 0.5 ppm for all samples with the exception of the sample from the 18 to 20 foot interval in B-3, which had a concentration of 150 ppm. Table 3-3 summarizes the soil boring findings. Boring logs are appended to the Final Site Investigation Report (ABB-ES, 1998).

Based on results of the removal and investigation, the former waste oil UST location at Building 202 was listed in the Fort Devens MEP as SA 48 - Building 202 Leaking Underground Storage Tank Site. The MEP recommended that the extent of contamination be delineated through the installation of soil borings to characterize soil contamination and monitoring wells to characterize groundwater contamination, if warranted.

3.2 Study Area 48 Site Investigation

In 1991, Ecology and Environment, Inc. (E&E) was tasked to perform a SI at SA 48. The results of the investigation were presented in the Final Site Investigations Report, December 1992 (E&E, 1992) (see Table 3-1).

3.2.1 Summary of Site Investigation Activities

As recommended in the MEP, the SI was designed to further characterize soil contamination associated with the former UST and to assess the effects of residual soil contamination on groundwater conditions in the vicinity of the SA. The SI activities consisted of the following:

- completing one soil boring (B202-BH1) and collecting soil samples for off-site laboratory analysis;
- installing three groundwater monitoring wells (B202-1 through B202-3);

- collecting two rounds of groundwater samples from the three newly installed monitoring wells; and

- performing hydraulic conductivity tests on the three newly installed monitoring wells.

One boring was completed to a depth of 32 feet bgs close to the excavation of the former waste oil UST for the purpose of characterizing residual contamination (see Figure 3-1). Samples were collected at 5-foot intervals and screened by an organic vapor analyzer (OVA). Seven soil samples from the boring were submitted to an off-site laboratory for TPH analysis. Three additional soil borings were advanced for the purpose of installing groundwater monitoring wells. The three water table monitoring wells were installed cross-gradient (B202-1), downgradient (B202-2), and upgradient (B202-3) from the former waste oil UST location (Figure 3-2). Soil samples were collected at 5-foot intervals to a depth of 32 feet bgs in all three borings. The soils were field screened by OVA.

Two rounds of groundwater samples were collected for laboratory analysis. The first round of samples (unfiltered) were collected in July 1991 and analyzed for TPH, Target Compound List (TCL) organics, Target Analyte List (TAL) inorganics, and cations/anions. In the second round of groundwater sampling, December 1991, also unfiltered, explosive compounds were added to the list of analytes.

3.2.2 Summary of Site Investigation Results and Observations

Soils encountered during the SI consisted of clean, poorly graded sands, and sands with gravels. Analytical results from boring B202-BH1 indicated the presence of TPH (1,350 milligrams per kilogram [mg/kg]) in only the surface-soil sample (see Table 3-3).

No detectable TPH was found in any Round 1 groundwater samples (Table 3-4). Elevated inorganic analyte concentrations were observed, but were attributed to high turbidity in the unfiltered samples. Elevated chloride and sodium were attributed to road deicing. The one organic compound detected (methylene chloride) was concluded to be the result of laboratory contamination.

In the second round of groundwater sampling TPH was again undetected in any of the samples. Except for general decreases, no significant changes in inorganic analyte

concentrations were noted in the unfiltered samples. An explosive compound, cyclonite, and a pesticide, aldrin, were both detected at low concentrations in the upgradient well (B202-3). Because of the location of the boring relative to the former tank location (i.e., upgradient), these compounds were determined not to be associated with the UST release. The low concentrations of methylene chloride and chloroform detected in wells were again attributed to laboratory contamination. The trace concentration of trichloroethylene detected in the crossgradient well was also determined to be not related to a release from the former UST.

Prior to sampling the newly installed monitoring wells, in-situ hydraulic conductivity tests were performed. The tests consisted of rising and falling head tests. E&E reported hydraulic conductivities that ranged from 0.02 to 0.10 feet per minute (E&E, 1992). Based upon three rounds of water level measurements E&E reported the direction of groundwater flow to be to the north-northeast and northeast.

3.2.3 Site Investigation Conclusions and Recommendations

The SI concluded there was no evidence of significant release of waste oil to groundwater or soil. Downgradient groundwater quality indicated no effects from residual petroleum contamination observed in the soil around the former UST. However, because of the presence of TPH in certain soil samples, E&E recommended that a removal action be performed at SA 48 on soil contaminated with residual TPH.

3.3 Study Area 48 Soil Removal Action

In October 1992, the United States Army Toxic and Hazardous Materials Agency prepared an Action Memorandum to document the decision to perform soil removal actions at SA 48. The Action Memorandum indicated that soil would be removed from two areas. The first area was in the immediate vicinity of B202-BH1, and the second was in the immediate vicinity of the former tank (see Figure 3-1). According to a memorandum entitled "Report of Field Activities", prepared for the USACE-New England Division Geotechnical Engineering Division (Schmidt, 1993), an excavation service contract was awarded to Site Remediation Services, Inc., by USACE-New England Division in November 1992. In April and May 1993, approximately 335 cy of soil were excavated from the two areas identified in the Action Memorandum. Of that volume, approximately 150 tons were segregated as contaminated with waste oil.

Contaminated soil observed on the wall closest to Building 202 ("northwestern wall" of the excavation) during the removal suggested possible contaminant migration beneath the Building 202 foundation. Excavation and soil removal was limited laterally by the presence of Building 202 (concerns for the integrity of the building's foundation), and vertically by the reach limitation of the excavator. Results of confirmatory screening, analytical results, and observations made during excavation suggested that waste oil contamination remained in subsurface soils adjacent to and possibly beneath Building 202, and in soil beneath a depth of 20 feet in the immediate vicinity of the former tank. Confirmatory samples collected from the excavation near Building 202 at the 4-foot, 15-foot, and 20-foot depths contained TPH at 118 ppm, 4,320 ppm, and 2,130 ppm, respectively. Other confirmatory samples generally contained TPH at less than the 50 ppm detection limit.

Excavation activities were suspended, the excavation was lined with polyethylene, and clean fill was added to bring the excavation up to grade. Two samples of the stockpiled contaminated soil were also collected by E&E personnel on May 13, 1993, and submitted for laboratory analysis for the full suite of Toxicity Characteristic Leaching Procedure (TCLP) analytes and RCRA hazardous characteristics (corrosivity, reactivity, and ignitability). On November 16, 1993, Webster Engineering Company of Dorchester, Massachusetts collected an additional seven soil samples from the stockpiled soil for further characterization in support of the soil disposal. One or more of the samples were analyzed for volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), semivolatile organic compounds (SVOCs), and TPH (both nondispersive infrared spectroscope [NDIR] and gas chromatograph/flame ionization detector [GC/FID]). On December 21, 1993, 132 tons of stockpiled soil from the April and May 1993 removal were transported by Merrimac Cartage, Inc. of North Andover, Massachusetts, from the site under Bill of Lading Number BWSC-012A/B/C, for disposal at the Waste Management Rochester, New Hampshire, landfill.

A SSI was recommended to characterize the extent of residual contamination associated with migration beneath the foundation and to provide confirmatory sampling results for the soil removal effort.

3.4 Study Area 48 Supplemental Site Investigation

A SSI was performed by ABB Environmental Services, Inc. (ABB-ES) in December 1993 and January 1994 under contract to USACE. The SSI was designed to characterize the distribution of residual contamination associated with SA 48.

3.4.1 Summary of Supplemental Site Investigation Activities

Fieldwork was performed between December 6, 1993, and January 11, 1994, in accordance with procedures presented in the SA 48 Final Work Plan dated November 1993 (ABB-ES, 1994a). The SSI included the installation of seven soil borings and one groundwater monitoring well, and soil and groundwater sampling and analysis. Soil samples were collected and field screened for TPH by NDIR. Selected soil and groundwater samples were submitted for confirmatory laboratory analysis. The SSI consisted of the following activities:

- performing a geophysical survey to locate safe drilling locations for intrusive explorations;
- drilling seven soil borings (48B-93-01X through 48B-93-06X, and 48B-93-09X) to collect subsurface-soil samples in and around the former waste oil UST location;
- installing one monitoring well (48M-93-04X) in the area of the former waste oil UST;
- collecting one round of groundwater samples from the newly installed monitoring well and the three existing monitoring wells; and
- surveying all new explorations (borings and well) and three pre-existing wells by a Massachusetts registered professional land surveyor.

Seven soil borings were drilled at SA 48 in and around the former UST location (see Figure 3-1) to characterize subsurface geologic materials and collect subsurface-soil samples for chemical analysis. Samples were collected at 5-foot intervals for on-site screening by NDIR, one sample per boring was sent to an off-site laboratory for TPH analysis.

A water table monitoring well was installed in boring 48B-93-04X and designated 48M-93-04X. This monitoring well was installed at the location of the former UST to assess potential groundwater contamination.

One round of groundwater samples was collected from the newly installed monitoring well and three existing monitoring wells. Groundwater samples were submitted for laboratory analysis of VOCs, SVOCs, filtered and unfiltered inorganics, and TPH.

3.4.2 Summary of Supplemental Site Investigation Results and Observations

Six of the seven soil borings were completed for the collection of soil samples. The seventh boring, 48B-93-04X, was installed at the former location of the UST to a depth of 40 feet bgs. Monitoring well 48M-93-04X was installed in the boring a depth of 38 feet bgs. Soils were described by the on-site geologist as clean, coarse to fine sands with subrounded gravels. Table 3-5 summarizes the soil boring findings.

A total of 41 soil samples was collected from the seven borings advanced during the SSI. Soil sample headspace was screened in the ABB-ES Fort Devens field laboratory for the presence of VOCs by PID and for TPH by NDIR. TPH was detected in two samples at concentrations exceeding the instrument detection limit of 50 ppm. TPH was detected at 250 ppm in the sample from 15 to 17 foot bgs interval in boring 48B-93-01X, located between Building 202 and the former tank location, and at 160 ppm in the 15-17 foot bgs sample from boring 48M-93-04X. Visual evidence of contamination (slight oil sheen on split-spoon sample) was encountered only in boring 48B-93-01X, at the 15-17 foot bgs interval.

The confirmatory sample results indicated that TPH was detected in the two samples from borings 48B-93-01X (100 mg/kg, average of field sample and its duplicate) and 48M-93-04X (180 mg/kg) (see Table 3-5). TPH was not detected at concentrations above the quantitation limit (25 mg/kg) in any other soil sample.

Groundwater samples from each of the monitoring wells were submitted for laboratory analysis of VOCs, SVOCs, filtered and unfiltered inorganics, and TPH. Table 3-6 presents a hits-only summary of the analytical results. TPH was not detected in groundwater samples from the four monitoring wells. Both filtered and unfiltered groundwater samples from each well were analyzed for TAL inorganics. Six metals were detected in both the filtered and unfiltered sample from one or more wells: barium, calcium, magnesium, manganese, potassium, and sodium. Aluminum, iron, and nickel were detected in the unfiltered (total) sample, but, because of their absence in the filtered (dissolved) samples, were determined to be the result of suspended solids in the samples.

Water-level measurements were made in the three pre-existing wells and the one new well to determine groundwater flow directions. The interpreted groundwater flow was determined to be to the northeast.

3.4.3 Supplemental Site Investigation Conclusions and Recommendations

As part of the SSI, a human-health preliminary risk evaluation (PRE) was completed to assess the risks associated with exposure to contaminants detected during the SSI. The results of the SSI PRE indicated that the residual contaminant concentrations detected in subsurface soil and groundwater did not pose a risk to human health. Based on the findings of the SSI field investigation and PRE, no further action was recommended for SA 48 (ABB-ES, 1994c). A No Further Action Decision Document was completed and signed in January 1995 (ABB-ES, 1995a).

3.5 AREE 61Z Supplemental Site Evaluation

Arthur D. Little, Inc. (ADL) performed a SSE at SA 61Z in 1994. A summary of the findings is presented below, but a complete assessment may be found in the Final Maintenance and Waste Accumulation Area (AREE 61) Report (ADL, 1995).

3.5.1 Summary of Supplemental Site Evaluation Activities

The SSE was designed to locate the dry well and assess the potential soil contamination present around the dry well or surface-soil contamination resulting from extended use of the adjacent unpaved parking lot for vehicle storage. The SSE included the following activities:

- performing a geophysical survey to identify safe drilling locations for intrusive explorations and to locate the dry well;
- advancing four Geoprobe® borings in the area of the dry well; and
- collecting 20 surface-soil samples from the motor pool area.

A geophysical survey, consisting of ground-penetrating radar (GPR), was performed in the area where the dry well was reportedly located. The purpose of the geophysical survey was to identify subsurface utility locations and to locate the dry well precisely. The survey

was performed in a 60-by-60-foot area with the survey lines spaced at 5- to 10-foot intervals. Several anomalies were identified and each was assessed.

Four Geoprobe® borings were advanced in the area where 1952 construction plans indicated the dry well existed (Figure 3-3). The locations of the Geoprobe® borings were constrained by the presence of overhead and underground utilities. Samples were collected from depth intervals of 4 to 6, and 8 to 10 feet bgs at each location except GP-1, where refusal was encountered at 5.5 feet bgs. Samples were screened in a field laboratory for TPH and benzene, toluene, ethylbenzene, and xylene (BTEX). The location where the highest TPH was detected was resampled and the sample submitted to a U.S. Army Environmental Center (USAEC) performance-demonstrated laboratory for analysis of VOCs, SVOCs, TAL metals, TPH, and total organic carbon (TOC).

Twenty surface-soil samples were collected from a depth of 0 to 1 foot bgs at locations throughout the unpaved parking area (Figure 3-4). The sample locations shown on Figure 3-4 are not based on survey data, but are interpreted based on Figure 6-7 of the AREE 61 report (ADL, 1995). Because these two figures show SA 61Z buildings other than Building 202 at substantially different locations, the locations of several of the surface soil samples relative to building locations differ between the figures. The soil samples were collected with a hand auger and screened for TPH and BTEX in a field laboratory. The seven locations with the highest TPH concentrations were resampled for analysis of VOCs, SVOCs, TAL metals, TPH, and TOC.

3.5.2 Summary of Supplemental Site Evaluation Results and Observations

Subsurface-soil samples from the dry well location did not exhibit odor or staining. The soils consisted of yellowish brown sand with little silt and gravel. TPH concentrations generally ranged from 8 to 173 ppm; however, two samples exceeded this range. In the 4- to 6-foot bgs sample from GP-1, TPH was detected at a concentration of 16,900 ppm, and the 4- to 6-foot bgs sample from GP-4 yielded a TPH concentration of 1,920 ppm.

Off-site laboratory analytical results from one Geoprobe® sample (61Z-94-08, GP-1) indicated that the compound 2-methylnaphthalene was detected at a concentration of 2.6 ppm, exceeding the then current Massachusetts Contingency Plan (MCP) Method 1 S-2/GW-1 Standard of 0.7 µg/g. . The Method 1 S-2/GW-1 Standard was used in the AREE 61 report because the sample was collected at a depth of 4 feet bgs. Benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)anthracene, and chrysene were also detected at 61Z-94-08 (GP-1, 4 to 6 feet bgs) at concentrations of 1.8, 2.3, 1.7, and 2.0 micrograms per kilogram (µg/kg), respectively.

The 20 surface-soil samples, collected throughout the unpaved parking lot, were analyzed in the field laboratory by NDIR and GC. Results indicated the presence of TPH in the surface soils (Table 3-7). BTEX was not detected in any of the samples. The average TPH concentration, excluding duplicates, was 360 ppm. TPH concentrations in 7 samples were greater than this value: HA-1, HA-2 and HA-3, all located near the southern boundary of the site, were found to have TPH concentrations of 673, 1,050, and 1,388 ppm, respectively. TPH concentrations in HA-11, identified by ADL as located near the garage, and HA-13, located near Building 202, were 630 and 1,195 ppm, respectively. Above average concentrations were also observed at HA-16 (389 ppm) and HA-18 (421 ppm), both located near the western end of Building 202. The average TPH concentration excluding the seven highest concentration samples was 112 ppm.

Analytical results from the seven surface-soil samples submitted to an off-site laboratory indicated that TPH, trichloroethene, and 2-methylnaphthalene were detected at concentrations exceeding the MCP Method 1 S-1/GW-1 Standard. At sample locations 61Z-94-01 (HA-3) and 61Z-94-03 (HA-2), TPH was detected at concentrations of 667 and 610 ppm, respectively. Trichloroethene was detected at sample location 61Z-94-07 (HA-16) at a concentration of 1.3 ppm. Sample locations 61Z-94-01 (HA-3), 61Z-94-03 (HA-2), and 61Z-94-05 (HA-11) had 2-methylnaphthalene concentrations of 1.2, 0.79, and 1.6 ppm, respectively.

Carcinogenic polynuclear aromatic hydrocarbons (PAHs) detected during the SA 61Z unpaved parking lot investigation consisted of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3,cd)pyrene. In four of the seven samples, the total concentrations of PAHs exceeded risk based concentrations used as screening benchmarks in the SSE report. A summary of the analytical results is presented in Table 3-8.

3.5.3 Supplemental Site Evaluation Conclusions and Recommendations

Based upon the field screening data and laboratory analytical results, a remedial evaluation was recommended by ADL for surface soil in the unpaved parking lot southwest of Building 202. In addition, the dry well was recommended for closure.

3.6 DRY WELL REMOVAL PROGRAM

OHM Remediation Services Corp. (OHM) was contracted by USACE to remove the dry well and to excavate associated petroleum-contaminated soil with TPH concentrations in excess of 500 mg/kg at SA 61Z. The dry well removal began on March 20, 1995 and continued through May 2, 1995. OHM collected soil samples from the base of the drywell for TPH field screening and off-site laboratory analysis consisting of TPH, RCRA metals, VOCs and PCBs. On the basis of the results, subsequent screening during excavation consisted of only TPH. A total of 73 field screening samples was collected to a depth of 23.5 feet bgs. All OHM soil samples were collected in the excavated area shown in Figure 3-3.

OHM also installed temporary well point TWP-1 north of the excavation to determine whether the groundwater had been affected by past site activities (see Figure 3-3). Groundwater was first encountered at 29 feet bgs. Two rounds of samples were collected from this well point and submitted for off-site laboratory analysis consisting of VOCs, SVOCs, and TPH. Soil and groundwater analytical results are discussed below, and a complete presentation of the groundwater sampling results is provided in the Immediate Response Action (IRA) Summary Report for AREE 61Z (OHM, 1995).

Based on field screening results, excavation proceeded to a depth of 15 feet bgs and until all sidewall samples had TPH concentrations less than 500 mg/kg. Although a hand auger sample collected at a depth of 17 feet bgs through the base of the excavation showed a TPH concentration of 2,043 ppm, additional excavation was not attempted because of concerns about undermining Building 202. Two hand auger samples from 23.5 feet bgs, also collected through the base of the excavation, showed TPH concentrations of 406 and 248 mg/kg.

The results of five confirmatory soil samples collected from the sidewalls of the excavation indicated that TPH concentrations ranged from nondetect to 28.6 mg/kg. Lead concentrations were below detection limits in four of the samples, and 2.21 mg/kg in the fifth. Confirmatory samples for off-site analysis were not collected from the bottom of the excavation.

The results of the groundwater sampling showed that the TPH concentration was 24.3 milligrams per liter (mg/L) in the Round 1 sample and 6.33 mg/L in the Round 2 sample. The only organic compounds detected were methylene chloride and bis(2-ethylhexyl)phthalate, which were apparent off-site laboratory contaminants and

were not identified as site-related contaminants. Numerous tentatively identified compounds were listed at low concentrations.

Based on the results of the soil and groundwater samples collected during the removal, it was recommended that an RI and Feasibility Study be performed to concentrate on groundwater contamination. The site designation was changed from AREE 61Z to AOC 61Z.

3.7 FUEL OIL UST REMOVAL PROGRAM

Roy F. Weston, Inc. (Weston) was contracted by the USACE to remove the 5,000-gallon No. 2 Fuel Oil UST located on the northeastern side of Building 202 (see Figure 3-3). The UST removal was performed in June 1996. Prior to removal of the UST, all residual product and sludge were removed, and the tank was pressure washed by Clean Harbors Environmental Services, Inc. Approximately 318 gallons of liquid, including remaining product, sludge, and wash water, were removed from the UST.

On June 11, 1996, Weston began removal of the UST. During excavation, headspace field screening samples were collected on approximately every 10 cy of soil. No headspace readings were recorded above ambient conditions. No apparent releases of fuel oil were noted in the sidewalls of the excavation, and the UST appeared in good condition upon its removal. Weston collected a total of eight samples from the excavation for TPH field screening by DEXSIL® PetroFlag Hydrocarbon Test Kit. TPH was detected in five of the six soil samples, ranging from 84 to 1,875 ppm. The highest concentrations were detected at the bottom of the excavation at a depth of approximately 9 feet bgs. TPH concentrations detected in the north wall and bottom of the excavation exceeded the applicable USEPA Soil Screening Guidance and the MCP Method 1 S-1/GW-1 clean-up standards of 500 ppm. Weston excavated the north wall and bottom of the excavation an additional 2 feet and collected another three screening samples (N-2, B-2, and B-3). In all three samples, TPH concentrations were below the screening detection limit of 25 ppm.

Seven composite samples were collected from the floors and walls of the excavation for confirmatory analysis by an off-site laboratory. The samples were analyzed for VOCs, SVOCs, and TPH. The results of the confirmatory samples indicated no detectable concentrations of VOCs, SVOCs, or TPH.

Based upon the results of the confirmatory samples, Weston recommended no further action for the former 5,000-gallon No. 2 Fuel Oil UST.

3.8 REMEDIAL INVESTIGATION PROGRAM

RI activities at SA 61Z were undertaken in accordance with the *Final Work Plans Areas of Contamination (AOCs) 50, 61Z, and 63BD Remedial Investigation and Feasibility Study* (ABB-ES, 1996), and the Revised *Final Project Operations Plan* (ABB-ES, 1995b). The RI field program was performed to characterize the distribution of petroleum contaminants in groundwater downgradient of SA 61Z. Although the field program was initiated as part of a RI, the subsequent change of site status from an AOC to a SA, resulted in reporting of study findings in a SI report (ABB-ES, 1998).

3.8.1 Summary of Remedial Investigation Activities

The RI field program was performed to characterize the distribution of petroleum contaminants in groundwater downgradient of SA 61Z. A summary of investigation activities completed during the RI field program is presented in Table 3-9. Locations of monitoring wells installed during the RI field program are presented in Figure 3-5.

The RI field program for SA 61Z consisted of the following elements:

- performing a GPR survey to clear exploration locations;
- drilling and sampling four soil borings for monitoring well installation;
- installing four monitoring wells;
- sampling subsurface soil for field and off-site laboratory analysis;
- field analysis of environmental samples using a field GC;
- well development;
- two rounds of groundwater sampling for off-site laboratory analysis;
- testing aquifer conductivity; and

- surveying exploration horizontal and vertical locations.

A surficial geophysical survey using GPR was performed in June 1996 to locate safe drilling locations for all of the intrusive explorations.

A total of four soil borings (61M-96-01X, 61M-96-02X, 61M-96-03A, and 61M-96-03B) were drilled downgradient and cross gradient of Building 202 and the former dry well location for soil classification, analytical sampling, and monitoring well installation. Split spoon samples were collected continuously from 15 feet bgs to completion in borings 61M-96-01X and 61M-96-03A, at approximate 5-foot intervals from ground surface to 15 feet bgs in boring 61M-96-02X and continuously to completion thereafter, and continuously from ground surface to completion in boring 61M-96-03B. A minimum of five samples per boring were collected from 15 to 35 feet bgs for extractable petroleum hydrocarbons and volatile petroleum hydrocarbons (EPH/VPH) field screening. These depths were chosen based on the results of the dry well removal which indicated that residual contamination, if present, would likely be found below 15 feet bgs. Two samples per boring were submitted for off-site laboratory analysis for EPH/VPH, TPH, and pH based on field PID measurements. In instances when no elevated PID readings were detected, a sample at or near the water table was submitted for analysis. In addition, one sample from the well screen interval was analyzed for TOC and grain size distribution.

Four monitoring wells were installed downgradient and crossgradient of the former dry well location. All were screened in overburden soil, three across the water table and one (61M-96-03B) fully beneath the water table. Monitoring well 61M-96-03B was installed to evaluate deep groundwater quality and paired with monitoring well 61M-96-03A to provide hydrologic data on vertical hydraulic gradients. Monitoring well construction was completed in accordance with USAEC requirements.

Monitoring well 61M-96-03B was completed approximately 10 feet west of monitoring well 61M-96-03A following abandonment of an initial installation of this monitoring well east of 61M-96-03A because of an obstruction in the well approximately 20 feet bgs which made it unusable. The monitoring well materials were removed to 1 foot bgs, and the remaining riser and well screen were grouted in place.

Because boring 61M-96-03B was redrilled a relatively short distance from its initial location, a decision was made not to repeat continuous split spoon sampling or EPH/VPH screening at five foot intervals at the second location. A single split spoon sample for

TOC and grain size distribution analysis was collected from the depth of the monitoring well screen; however, the boring log, soil screening, and EPH/VPH data associated with monitoring well 61M-96-03B are based upon samples collected at the original location. The TOC and grain size data for boring 61M-96-03B, and the monitoring well construction data are from the present monitoring well location.

Each of the newly installed monitoring wells was developed using the pump and surge method to remove water added to the boring during drilling and/or well installation, and to remove sediment from the monitoring well screen prior to groundwater sampling and aquifer testing. In-situ hydraulic conductivity tests were performed on the each of the four monitoring wells installed during the RI and the four existing monitoring wells to obtain estimates of hydraulic conductivity.

The data from all in-situ hydraulic conductivity tests were analyzed using the method of Hvorslev (1951). In addition, hydraulic conductivities were estimated by the methods of Hazen (1911) and Masch and Denny (1966) using grain size data collected during monitoring well installation.

Two rounds of groundwater samples were collected from the four new and two existing (B202-3 and TWP-1) monitoring wells (see Figure 3-5). The first round of samples was collected in July 1996, and the second round was collected in October 1996. The groundwater samples for these two rounds were submitted for laboratory analysis consisting of EPH/VPH, TPH, and water quality parameters.

3.8.2 Summary of Remedial Investigation Results and Observations

This subsection summarizes the results of field screening and off-site laboratory chemical analyses performed during RI field activities at SA 61Z. RI field activities included collecting a limited number of subsurface-soil samples, but did not include any surface-soil sampling.

During RI field activities subsurface-soil samples were collected at approximate 5-foot intervals between 15 feet bgs and the water table from four monitoring well borings (61M-96-01X, 61M-96-02X, 61M-96-03A, and 61M-96-03B) and field screened for EPH/VPH. The purpose of these samples was to help assess the extent that contaminants may have migrated laterally from the dry well and to assess whether extensive soil contamination existed at the water table. EPH/VPH were not detected in any of the field screening samples.

Confirmatory samples for off-site laboratory analysis were collected from each boring at a depth corresponding to the water table and analyzed for TPH by USEPA Method 418.1, EPH/VPH by the Massachusetts Health Based Methodology, TOC, and pH (Table 3-10). Review of the off-site data shows that TPH concentrations were below detection limits in all samples analyzed by USEPA Method 418.1, and EPH/VPH concentrations were below reporting limits in all but one sample analyzed according to the Massachusetts Health Based Methodology; C_9 to C_{12} aliphatics were detected at 420 µg/kg in the sample from 25 feet bgs at boring 61M-96-03A.

Based on these data and consideration of the IRA Summary Report (see Subsection 3.6) (OHM, 1995), it was concluded that extensive lateral migration of contaminants had not occurred at the water table.

Two rounds of groundwater samples were collected from monitoring wells B202-3, TWP-1, 61M-96-01X, 61M-96-02X, 61M-96-03A, and 61M-96-03B and analyzed for TPH by USEPA Method 418.1, and EPH/VPH by Massachusetts TPH methodology. In addition, several water quality and bioremediation assessment parameters were included to provide data potentially useful to the assessment of remedial actions for the cleanup of groundwater during the anticipated feasibility study and are not identified or discussed as site-related contaminants. Table 3-11 summarizes the TPH and EPH/VPH data, and Table 3-12 summarizes the water quality and bioremediation assessment parameter results.

Review of the tabulated data shows that TPH by USEPA Method 418.1 were detected in only two of six Round 1 samples (from monitoring wells 61M-96-01X and TWP-1) and in only one Round 2 sample (from monitoring well TWP-1). Several-fold concentration decreases occurred between Round 1 and Round 2 in each case; the concentration at 61M-96-01X dropping from 954 to less than 174 micrograms per liter (µg/L), and the concentration at TWP-1 dropping from 5,200 to 347 µg/L. TPH was not detected in the deep groundwater monitoring well 61M-96-03B.

In comparison, the Massachusetts Health Based Methodology showed EPH/VPH in four of six Round 1 samples, with the highest concentration, 6,550 µg/L, appearing in monitoring well TWP-1. Only compounds in the EPH fraction were detected in Round 1; no specific target EPH compounds were identified. EPH concentrations were below reporting limits in all six Round 2 samples, and no target EPH compounds were identified.

Low concentrations of VPH were reported in five of six Round 2 samples; however, the consistency of reported concentrations, even in upgradient monitoring well B202-3, and

absence of detected VPH in Round 1 samples suggested that the VPH values represented laboratory or field introduced contamination. With the exception of these low VPH concentrations, EPH/VPH were not detected in the deep groundwater monitoring well 61M-96-03B.

The Round 1 samples showed that relatively high levels of fuel contamination existed in shallow groundwater downgradient of the former dry well location at that time. The Round 2 samples showed only low concentrations of VPH and indicated that groundwater quality had improved significantly. This was attributed to removal of the dry well that was the interpreted contaminant source, to attenuation of fuel compounds in groundwater by sorption and biological degradation, and to dispersion and dilution.

As part of the SA 61Z SI, ABB-ES performed a Human-health Risk Characterization for SA 61Z based on the Guidance For Disposal Site Risk Characterization, Interim Final Policy (MADEP, 1995a). Although SA 61Z is part of a Superfund site, contamination is limited to petroleum compounds that are not considered hazardous substances under CERCLA and which would not ordinarily be addressed in a CERCLA Risk Assessment. However, because of the planned property transfer at SA 61Z, a risk assessment based on the MCP Method 3 approach was judged to be appropriate for the site. No current exposure to subsurface soil exists at the site. The risk characterization assumed future use of the site would include office or light industrial buildings and activities, consistent with the Devens Reuse Plan (Vanasse Hangen Brustlin, Inc., 1994). The evaluated future receptor based on foreseeable land use conditions was a commercial/industrial worker ingesting groundwater from the site. Evaluated chemicals of concern in groundwater were VPH and EPH fractions of TPH.

Inorganics were not evaluated because 1) they were not included in the suite of analyses performed during the SA 61Z RI/SA, and 2) review of the most recent inorganic data (see Table 3-6) showed all reported concentrations to be less than applicable MCLs and SMCLs, and 3) the PRE of the SSI report concluded that groundwater does not present unacceptable risk.

Based on the classification scheme described in 310 CMR 40.0933 (5), (6), and (7), the risk assessment considered subsurface soil at SA 61Z as S-3 (isolated subsurface) for current and future exposures for the following reasons.

- Soil in the contaminated areas was excavated to 15 feet bgs and replaced with clean fill, so soil contamination onsite occurs only at depths greater than 15 feet bgs.

- Subsurface soils at depths greater than 15 feet bgs are not likely to be brought to the surface in the future.

Groundwater categories GW-1 and GW-3 were considered to be applicable to groundwater beneath SA 61Z because of the possibility of future potable use. The GW-2 category was considered not applicable because the average annual depth to groundwater is approximately 30 feet bgs.

The MCP states that a condition of no significant risk of harm to human health exists if the following conditions are met:

- no exposure point concentration of oil or hazardous material is greater than an applicable or suitably analogous public health standard;

- no cumulative receptor cancer risk is greater than the cumulative cancer risk limit; and

- no cumulative receptor noncancer risk is greater than the cumulative noncancer risk limit.

The SI risk characterization concluded that a condition of no significant risk of harm to health and public welfare exists at the site for current or for future commercial/industrial exposure conditions, for the following reasons:

- Concentrations of analytes do not exceed MADEP proposed upper concentration limits for EPH/VPH fractions.

- Estimated noncarcinogenic risks associated with groundwater did not exceed the cumulative noncancer risk limit of a HI equal to 1.

- No state or federal drinking water standards were exceeded; however, no Massachusetts Drinking Water Quality Standards, USEPA MCLs, or MCLGs have been established for TPH or its EPH and VPH fractions.

Because the VPH and EPH fractions are not established as carcinogenic, no cumulative receptor cancer risk was calculated. [Subsection 5.2 of this decision document updates the SI risk characterization by evaluating potential residential exposure to groundwater.]

The SA 61Z SI report provided a qualitative, rather than quantitative, ecological risk evaluation because subsurface soil in the contaminated areas was excavated to 15 feet bgs and replaced with clean fill making it unlikely that ecological receptors would contact contaminants. Although groundwater flow is towards Plow Shop Pond and Grove Pond (approximately 2,000 feet to the northeast), available data indicate that contaminant concentrations in groundwater are declining near the former location of the dry well and that contaminants are not migrating downgradient at concentrations of potential concern. Because of this, ecological exposure to groundwater at downgradient discharge locations was not expected to result in unacceptable risks.

3.8.3 Remedial Investigation Conclusions and Recommendations

The SA 61Z SI report listed the following conclusions and recommendations concerning contamination and potential exposure risks at SA 61Z.

- Surface soils in portions of the unpaved parking lot southwest of Building 202 are contaminated with carcinogenic PAHs at concentrations that exceed screening values used in the SSE report.

- Subsurface-soil sampling in the vicinity of the Building 202 dry well has shown that the dry well removal activities successfully removed petroleum contaminated soil exceeding the MADEP action limit of 500 mg/kg to a depth of 15 feet bgs. Concentrations of residual petroleum contamination measured as TPH in soil deeper than 15 feet bgs decrease to 248 ppm at 23.5 feet bgs.

- Subsurface-soil sampling from the bottom and sides of the Building 202 No. 2 Fuel Oil UST excavation indicate that removal activities removed all contaminated soil with TPH concentrations exceeding 25 ppm.

- Groundwater samples collected in August 1996 showed petroleum contamination of up to 6,550 µg/L existed in shallow groundwater downgradient of the former dry well location. Samples collected in November 1996 showed only low concentrations (21 µg/L) of TPH and indicated that groundwater quality had improved significantly. This is attributed to removal of the dry well that was the

interpreted contaminant source, to attenuation of fuel compounds in groundwater by sorption and biological degradation, and to dispersion and dilution.

- Targeted VOCs and SVOCs analyzed for as part of the VPH/EPH methodology were not detected in groundwater samples at the site.

- A baseline human-health risk assessment based on the MCP Method 3 approach demonstrated that no significant risk associated with commercial/industrial exposure to groundwater exists at the site.

- No further response action regarding the SA 61Z dry well or the No. 2 Fuel Oil UST is required of the Army.

3.9 JULY 1999 WASTE OIL UST REMOVAL

During the demolition of Building 202 by Massachusetts Development (MASS DEV) in July 1999, a contractor's excavator punctured a previously undocumented UST located next to the south side of Building 202 (Figure 3-6) (Tighe&Bond, 1999). The punctured tank released an estimated 10 gallons of petroleum material assumed to be waste oil. MASS DEV notified the MADEP of the release on July 12, 1999, and an Immediate Response Action for tank and soil removal activities was performed under Release Tracking Number (RTN) 2-11210.

On July 19, 1999, representatives of MASS DEV oversaw the removal of the 1,000 gallon tank, as indicated on the manufacturer's nameplate, as well as visibly contaminated soil. The extent of soil excavation was assessed in the field by screening four sidewall samples and one bottom sample with a Dexsil Petroflag Total Petroleum Hydrocarbon kit. Field screening indicated TPH concentrations in four sidewall samples ranging from 38 to 207 ppm and a TPH concentration in the bottom sample of 44 ppm.

In addition, a composite of the four sidewall samples and a portion of the bottom sample were submitted for confirmatory EPH/VPH analysis. The confirmatory samples had nondetectable results for all EPH and VPH target analytes and all VPH carbon fractions. EPH carbon fractions were not detected in the bottom sample. The sidewall composite had the following concentrations reported for EPH carbon fractions: C_9 to C_{18} aliphatics, 5.8 mg/kg; C_{19} to C_{36} aliphatics, 39 mg/kg; and C_{11} to C_{22} aromatics, undetected.

The final excavation was approximately 15 by 16 ft at the ground surface and 10 feet deep. It was backfilled with clean sand and gravel following completion of excavation activities. The excavated oil-contaminated soil was transported to American Reclamation in Charlton, Massachusetts for asphalt batching.

The Underground Storage Tank Removal Report concluded that removal of the contaminated soil and backfilling with clean material achieved a condition of No Significant Risk of harm to public health, safety, and welfare, and the environment (Tighe&Bond, 1999).

4.0 CONTAMINATION ASSESSMENT

This contamination assessment summarizes subsurface soil and groundwater contamination at SA 61Z based on samples collected during the soil removal actions and site characterization activities discussed in Section 3.0.

4.1 SUBSURFACE SOIL

Subsurface soil characterization at SA 61Z was performed in association with four potential source areas:

- a former waste oil UST located on the southeast side of Building 202 (SA 48)
- the former dry well located at the east end of Building 202
- the former fuel oil UST located at northeast corner of Building 202
- a second waste oil UST also located on the southeast side of Building 202 (SA 61Z)

Waste Oil UST (SA 48). Samples collected in 1989 from the bottom and side walls of the excavation to remove the waste oil UST at SA 48 revealed evidence of subsurface soil contamination extending beyond the excavation limits. This resulted in a SI to further characterize the contamination and a 1993 soil removal action. Approximately 335 cy of soil were excavated during the removal action. Confirmatory samples from the bottom and side walls of the excavation generally contained TPH at less than the 50 ppm detection limit. Exceptions occurred, however, near Building 202 at the 4-foot, 15-foot, and 20-foot depths where samples contained TPH at 118 ppm, 4,320 ppm, and 2,130 ppm, respectively.

Subsequent to the soil removal action, a SSI was performed in December 1993 and January 1994 to further characterize the distribution of residual contamination associated with SA 48. Seven soil borings were completed and a total of 41 soil samples collected. Field analysis by NDIR showed only two samples with TPH concentrations exceeding the instrument detection limit of 50 ppm. TPH was detected at 250 ppm in the sample from 15-17 foot bgs interval in boring 48B-93-01X, located between Building 202 and the former tank location, and at 160 ppm in the 15-17 foot bgs sample from boring 48M-93-04X through the interpreted footprint of the former UST. Confirmatory sample results from an off-site laboratory showed TPH in the sample from boring 48B-93-01X to

be 100 mg/kg (average of field sample and its duplicate) and in the sample from boring 48M-93-04X to be 180 mg/kg. TPH was not detected at concentrations above the quantitation limit (25 mg/kg) in any other confirmatory soil sample.

Dry Well. The SSE performed in 1994 to characterize contamination associated with the dry well showed high concentrations of TPH in two 4- to 6-foot bgs samples. To reduce potential risks, USACE, in 1995, contracted removal of the dry well and excavation of associated petroleum-contaminated soil with TPH concentrations exceeding 500 mg/kg. Soil samples were collected from the base of the drywell for TPH field screening and off-site laboratory analysis consisting of TPH, RCRA metals, VOCs and PCBs. On the basis of the results, subsequent screening during excavation consisted of only TPH. A total of 73 field screening samples was collected to a depth of 23.5 feet bgs.

Based on field screening results, excavation proceeded to a depth of 15 feet bgs and until all sidewall samples had TPH concentrations less than 500 mg/kg. Although a hand auger sample collected at a depth of 17 feet bgs through the base of the excavation showed a TPH concentration of 2,043 ppm, additional excavation was not attempted because of concerns about undermining Building 202. Two hand auger samples from 23.5 feet bgs, also collected through the base of the excavation, showed TPH concentrations of 406 and 248 mg/kg. Excavated soil was replaced with clean fill.

The results of five confirmatory soil samples collected from the sidewalls of the excavation indicated that TPH concentrations ranged from nondetect to 28.6 mg/kg. Lead concentrations were below detection limits in four of the samples, and 2.21 mg/kg in the fifth. Confirmatory samples for off-site analysis were not collected from the bottom of the excavation.

During RI field activities, subsurface-soil samples were collected at approximate 5-foot intervals between 15 feet bgs and the water table from four monitoring well borings (61M-96-01X, 61M-96-02X, 61M-96-03A, and 61M-96-03B) and field screened for EPH/VPH. The purpose of these samples was to help assess the extent that contaminants may have migrated laterally from the dry well and to assess whether extensive soil contamination existed at the water table. EPH/VPH were not detected in any of the RI field screening samples.

Confirmatory samples for off-site laboratory analysis were collected from each boring at a depth corresponding to the water table and analyzed for TPH by USEPA Method 418.1, EPH/VPH by the Massachusetts Health Based Methodology, TOC, and pH. TPH concentrations were below detection limits in all samples analyzed by USEPA Method

418.1, and EPH/VPH concentrations were below reporting limits in all but one sample analyzed according to the Massachusetts Health Based Methodology; C_9 to C_{12} aliphatics were detected at 420 µg/kg in the sample from 25 feet bgs at boring 61M-96-03A.

Fuel Oil UST. The fuel oil UST was removed in June 1996. Although high TPH concentrations were noted during removal, excavation continued until TPH concentrations in all screening samples were below the screening detection limit of 25 ppm.

Seven composite samples were collected from the floors and walls of the excavation for confirmatory analysis by an off-site laboratory. The samples were analyzed for VOCs, SVOCs, and TPH. The results of the confirmatory samples indicated no detectable concentrations of VOCs, SVOCs, or TPH.

Waste Oil UST (SA 61Z). The SA 61Z waste oil UST was removed in July 1999 along with visibly contaminated soils. Analysis of confirmatory samples from the excavation sidewalls and bottom for EPH/VPH showed nondetectable results for all EPH and VPH target analytes and all VPH carbon fractions. EPH carbon fractions were not detected in the bottom sample. The sidewall composite had the following concentrations reported for EPH carbon fractions: C_9 to C_{18} aliphatics, 5.8 mg/kg; C_{19} to C_{36} aliphatics, 39 mg/kg; and C_{11} to C_{22} aromatics, undetected.

Subsurface Soil Summary. Analysis of confirmatory soil samples collected as part of soil removal actions and site characterization activities at SA 48 and SA 61Z indicates that remaining TPH concentrations are generally below 50 ppm in soils up to 15 feet deep. The exception to this is detection of TPH at 118 ppm in a 4 foot bgs sample collected next to Building 202 at SA 48. However, subsequent sampling at SA 48 did not show TPH above reporting limits (25 ppm) at this depth interval.

Analysis of samples collected deeper than 15 feet bgs showed a TPH concentration of 4,320 ppm at 15-to 17-feet bgs at SA 48 and 2,043 ppm at 17 feet bgs at the SA 61Z dry well.

4.3 GROUNDWATER

Groundwater characterization at SA 48 and SA 61Z was accomplished through installation of seven monitoring wells and collection of seven rounds of groundwater samples. Table 4-1 summarizes the groundwater sampling and analysis performed at SA 48 and SA 61Z. Initial groundwater characterization occurred during the SA 48 SI which included collection of two rounds of samples from 3 monitoring wells. Round 1 samples were analyzed for TPH, VOCs, SVOCs, and cations/anions. No detectable TPH was found in any Round 1 groundwater samples (see Table 3-4). Elevated inorganic analyte concentrations were observed, but were attributed to high turbidity in the unfiltered samples. Elevated chloride and sodium were attributed to road deicing. The one organic compound detected (methylene chloride) was concluded to be the result of laboratory contamination.

In the second round of groundwater sampling TPH was again undetected in any of the samples. Except for general decreases, no significant changes in inorganic analyte concentrations were noted in the unfiltered samples. An explosive compound, cyclonite, and a pesticide, aldrin, were both detected at low concentrations in the upgradient well (B202-3), but these compounds were determined not to be associated with the UST release. The low concentrations of methylene chloride and chloroform detected in wells were again attributed to laboratory contamination. The trace concentration of trichloroethylene detected in the crossgradient well was also determined to be not related to a release from the former UST.

During the SA 48 SSI, samples were collected from the three monitoring wells of the SI, plus one new monitoring well. Groundwater samples were submitted for laboratory analysis of TPH, VOCs, SVOCs, and filtered and unfiltered inorganics. TPH was not detected in groundwater samples from the four monitoring wells (see Table 3-6). Both filtered and unfiltered groundwater samples from each well were analyzed for TAL inorganics. Six metals were detected in both the filtered and unfiltered sample from one or more wells: barium, calcium, magnesium, manganese, potassium, and sodium. Aluminum, iron, and nickel were detected in the unfiltered (total) sample, but, because of their absence in the filtered (dissolved) samples, were determined to be the result of suspended solids in the samples.

One additional monitoring well was installed during the Dry Well Removal program. It was sampled twice, for TPH, VOCs, and SVOCs, as part of the dry well removal. The results of the groundwater sampling showed that the TPH concentration was 24.3 mg/L in the Round 1 sample and 6.33 mg/L in the Round 2 sample. The only organic

compounds detected were methylene chloride and bis(2-ethylhexyl)phthalate, which were apparent off-site laboratory contaminants and were not identified as site-related contaminants. Numerous tentatively identified compounds were listed at low concentrations.

During RI field activities, two rounds of groundwater samples were collected from monitoring wells B202-3, TWP-1, 61M-96-01X, 61M-96-02X, 61M-96-03A, and 61M-96-03B and analyzed for TPH by USEPA Method 418.1 and EPH/VPH by Massachusetts TPH methodology.

Review of the tabulated data (see Table 3-11) shows that TPH by USEPA Method 418.1 were detected in only two of six Round 1 samples (from monitoring wells 61M-96-01X and TWP-1) and in only one Round 2 sample (from monitoring well TWP-1). Several-fold concentration decreases occurred between Round 1 and Round 2 in each case; the concentration at 61M-96-01X dropping from 954 to less than 174 µg/L, and the concentration at TWP-1 dropping from 5,200 to 347 µg/L. TPH was not detected in the deep groundwater monitoring well 61M-96-03B.

In comparison, the Massachusetts Health Based Methodology showed EPH/VPH in four of six Round 1 samples, with the highest concentration, 6,550 µg/L, appearing in monitoring well TWP-1. Only compounds in the EPH fraction were detected in Round 1; no specific target EPH compounds were identified. EPH concentrations were below reporting limits in all six Round 2 samples, and no target EPH compounds were identified. Specific EPH compounds targeted but not detected consist of naphthalene, 2-methylnaphthalene, acenaphthylene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-c,d)pyrene, phenanthrene, and pyrene.

Low concentrations of VPH were reported in five of six Round 2 samples; however, the consistency of reported concentrations, even in upgradient monitoring well B202-3, and absence of detected VPH in Round 1 samples suggests that the VPH values may represent laboratory or field introduced contamination. With the exception of these low VPH concentrations, EPH/VPH were not detected in the deep groundwater monitoring well 61M-96-03B. Specific VPH compounds targeted but not detected consist of BTEX, naphthalene, and methyl tert-butyl ether.

The Round 1 samples show that relatively high levels of fuel contamination existed in shallow groundwater downgradient of the former dry well location at that time. The

Round 2 samples show only the low concentrations of VPH and indicate that groundwater quality has improved significantly. This is attributed to removal of the dry well that was the interpreted contaminant source, to attenuation of fuel compounds in groundwater by sorption and biological degradation, and to dispersion and dilution.

Groundwater Contamination Summary. Relatively high concentrations of inorganics were detected in unfiltered groundwater samples from SA 48/SA 61Z during initial sampling activities, however, subsequent collection and analysis of filtered and unfiltered sample indicated that initial results were affected by suspended solids. Inorganics are interpreted not to be contaminants at SA 48/SA 61Z. Site related VOCs and SVOCs were not detected.

TPH was detected in the Dry Well Removal Program samples from monitoring well TWP-1, in SA 61Z RI Round 1 samples from monitoring wells TWP-01 and 61Z-96-01X, and in SA 61Z RI Round 2 samples from monitoring well TWP-01. Concentrations appear to be declining, and the most recent data (i.e., 347 µg/L in the SA 61Z RI Round 2 sample from TWP-01) are considered the most representative. EPH/VPH contamination as represented by SA 61Z RI Round 2 samples has decreased to sporadic near detection limit concentrations (see Table 3-11).

5.0 PRELIMINARY RISK EVALUATION

This section presents a PRE for the subsurface soil at SA 61Z and an updated PRE for groundwater. As discussed in Section 3.0, previous investigations at SA 61Z have addressed soil in the vicinity of a former dry well, soil at a No. 2 Fuel Oil UST, soil at a waste oil UST, and groundwater. All recommended removal actions have been completed, and previous risk evaluations indicate that subsurface soil does not pose unacceptable exposure risks for commercial/industrial land use. The risk characterization of the SI report indicated that commercial/industrial exposure to groundwater does not pose an unacceptable risk. The SI report did not evaluate either soil or groundwater for unrestricted land use (i.e., residential exposure).

This PRE demonstrates that subsurface soil and groundwater at SA 61Z do not pose a significant health risk for future unrestricted (residential) land use. This finding enables transfer of property at SA 61Z to the Massachusetts Government Land Bank for unrestricted use.

5.1 SUBSURFACE SOIL PRELIMINARY RISK EVALUATION

This subsection presents the PRE for subsurface soil at SA 61Z.

5.1.1 Background and Approach

SA 61Z, an Historic Motor Pool, consisted of several maintenance and repair buildings; sources of oil contamination included USTs and a dry well. SA 61Z consists of a triangle shaped property bounded on the east and northwest by St. Mihiel and Carey streets, and on the southwest by a former railroad siding (see Figure 2-2). The Army plans to transfer the property to the Massachusetts Government Land Bank for unrestricted use, although the site will only be used for commercial/industrial development. Portions of the site have recently undergone earth-moving activities in preparation for transfer and re-development.

This PRE is a streamlined evaluation that focuses on assessing whether significant exposure pathways and analytes of concern at the site pose a health risk that would prohibit the site from being released for future unrestricted land use. The PRE was performed to assess whether potential exposure to the contamination would be associated with acceptable cumulative cancer and noncancer risks. This evaluation was performed

by calculating an exposure point concentration (EPC) for each chemical of potential concern (COPC), and then quantitatively evaluating exposure doses and risks using default exposure assumptions recommended by USEPA. The cumulative risks were compared to USEPA cumulative receptor risk limits to determine if the health risks were acceptable.

The data evaluated in this PRE are from site investigation and confirmatory subsurface-soil samples collected during the various investigations at SA 61Z (see Section 3.0). Data associated with soils that were removed from the site during the various soil removal actions were not evaluated. In addition, only soils between the surface and 15 ft bgs were evaluated because potential exposure to deeper soils would not be expected under future land use (i.e., excavations would not be advanced to deeper soils). In reality, only contact with the top few feet of soil is anticipated for future occupants of the site; contact with deeper soils would only potentially occur during short-term excavation activities. USEPA Region I considers soils between 1 and 10 ft bgs to be potentially accessible subsurface soils (USEPA, 1995), whereas MADEP considers soils as deep as 15 ft bgs to be potentially accessible. To provide a conservative assessment that meets both USEPA and MADEP regulatory guidance, soils 0 to 15 ft bgs were evaluated in this PRE.

5.1.2 Chemicals of Potential Concern

COPCs are analytes that are potentially related to contamination sources at the site and are present at concentrations that may pose a health risk of concern.

The only chemical detected in soils 0 to 15 ft bgs was petroleum measured as TPH. Although some EPH/VPH samples were collected, no target compounds (i.e., PAHs or BTEX) were detected. Therefore, the only COPC in subsurface soil is TPH.

5.1.3 Cumulative Receptor Risks

Cumulative receptor risks were calculated to assess whether the COPCs were present at concentrations that could pose a significant health risk for the future residential use of the site. Calculation of cumulative receptor risks involved four components:

1. Calculation of COPC exposure point concentrations
2. Calculation of receptor COPC intakes
3. Quantification of COPC toxicity
4. Calculation of risks

5.1.3.1 Calculation of COPC Exposure Point Concentrations. Review of analytical data for confirmatory soil samples (see Section 4) indicates that TPH was detected only sporadically and at relatively low concentrations in soils between 0 and 15 ft bgs. To provide a conservative assessment of potential risks, the maximum detected TPH concentration in confirmatory soil samples is used as the exposure point concentration.

The highest detection concentration of TPH is 118 ppm in a 4 foot bgs sample collected next to Building 202 at SA 48. Therefore, this TPH concentration is used as the exposure point concentration.

5.1.3.2 Calculation of Receptor COPC Intakes. Intakes and risks for residential land use were quantified for adult and child residents in accordance with USEPA Region I risk characterization guidance (USEPA, 1994). Tables B-1 through B-4 of Appendix B provide documentation of the exposure parameters and intake calculations. Adult residents are assumed to be exposed to soils via incidental ingestion, dermal contact, and dust inhalation 150 days per year for 24 years. Child residents are assumed to be exposed to soils via the same exposure routes for 150 days per year, over a six-year period. Ingestion exposures are quantified assuming a 100 mg/day soil ingestion rate for adults, and a 200 mg/day soil ingestion rate for children (USEPA, 1994).

Dermal exposures were calculated using the skin surface area exposed to soil and the soil adherence factor. As recommended in recent USEPA guidance (USEPA, 1998), the soil adherence factor for adult residents is 0.08 milligrams per square centimeter (mg/cm^2), and the soil adherence factor for child residents is 0.3 mg/cm^2. Skin surface areas are 5,700 cm^2 for the adult, and 2,900 cm^2 for the child.

5.1.3.3 Quantification of COPC Toxicity. Risks were calculated by combining COPC intakes with dose-response data that quantify the toxicity associated with each COPC. USEPA does not publish dose-response data for petroleum hydrocarbons. However, MADEP publishes reference doses for petroleum hydrocarbon fractions (i.e., EPH and VPH fractions). In the absence of EPH and VPH data, MADEP recommends that the dose response values for the EPH fraction with the most conservative reference doses be used (MADEP, 1997). Therefore, the most conservative reference dose among all EPH and VPH fractions (0.03 mg/kg/day) was used as the reference dose to evaluate TPH toxicity. MADEP guidance indicates that petroleum hydrocarbon fractions are not considered potentially carcinogenic. Therefore, no cancer slope factors have been published for TPH.

5.1.3.4 Calculation of Noncancer Risks. The table below summarizes the risk estimates for receptor scenarios. Tables B-1 through B-4 (see Appendix B) present the detailed risk calculations. Cumulative cancer risks were not calculated because petroleum measured as TPH is not considered to be carcinogenic (in addition, no target potentially carcinogenic PAH compounds have been detected at the site). Non-cancer risks for the child and adult resident are each below the USEPA threshold noncancer risk limit of an HI of 1.

Based on this evaluation, the subsurface soils at SA 61Z do not pose a significant health risk for future unrestricted land use.

SUMMARY OF SUBSURFACE SOIL RESIDENTIAL NONCANCER EXPOSURE RISKS

	Receptor	
Exposure Pathway	**Child Resident**	**Adult Resident**
Ingestion	0.02	0.002
Dermal Contact	0.01	0.002
Particulate Inhalation	0.00004	0.00001
Total HI	0.04	0.004

5.1.4 Uncertainties and Interpretation

Because the PRE provides a very conservative assessment of potential risks, it is unlikely that risks associated with exposures that may actually occur under future site use would exceed the risks estimated in this PRE.

- Actual site use is expected to be commercial/industrial. Under these circumstances, children would not be exposed to soils under high frequency or intensity, as is assumed in the residential exposure scenario.

- It is unlikely that persons other than excavation workers would be exposed to soils beneath ~3 ft bgs. Therefore, evaluation of long-term exposures to subsurface soils provides a very conservative assessment of potential risks.

- Use of the maximum concentration as the exposure point concentration represents a very conservative approach. The 95% upper confidence level on the arithmetic mean concentration, or even the arithmetic mean concentration, provides a better estimate of a reasonable maximum exposure point concentration.

- The maximum detected TPH concentration (118 mg/kg) is below the TPH detection limit of 500 mg/kg that was associated with some confirmatory sample programs. Therefore, it is theoretically possible that some soils 0 to 15 ft bgs could contain residual TPH at concentrations between 118 mg/kg and 500 mg/kg. However, the hazard index values for child and adult resident exposures to 500 mg/kg TPH would still be well below the threshold HI value of 1 (i.e., child HI would be ~0.2 for exposure to 500 mg/kg TPH). Therefore, this uncertainty does not affect the conclusions of the PRE.

5.2 GROUNDWATER PRELIMINARY RISK EVALUATION UPDATE

Because property at SA 61Z is intended for commercial/industrial development, the SA 61Z SI Report evaluated risks associated with potable use of groundwater by commercial/industrial workers; residential use of the groundwater was not evaluated.

To further assess potential site risks, this decision document evaluated potable use of the groundwater by residential receptors. Tables B-5 and B-6 (see Appendix B) present the risk calculations for potable use of groundwater by child and adult residential receptors (i.e., ingestion and dermal contact). To streamline the evaluation, risks to potential residential receptors were calculated for monitoring well TWP-1 which had the greatest contaminant concentrations (see Table 3-11); potential risks for other monitoring wells would be less than the risk for monitoring well TWP-1.

Inorganics were not evaluated because 1) they were not included in the suite of analytes performed during the SA 61Z RI/SA, and 2) review of the most recent inorganic data (i.e., the SSI data Table 3-6) shows all reported concentrations to be less than applicable MCLs and SMCLs, and 3) the PRE of the SSI report concluded that groundwater does not present unacceptable risk.

As discussed in Section 3.0, groundwater concentrations at SA 61Z have decreased since remediation of the soils. Although the most recent round of groundwater data represents more realistic exposure concentrations, residential risks were evaluated for the temporal average concentration of both rounds of groundwater data collected from monitoring well TWP-1. This approach provides a more conservative evaluation of possible health risks. Calculated HIs are summarized below.

SUMMARY OF GROUNDWATER RESIDENTIAL NONCANCER EXPOSURE RISKS

Exposure Pathway	Receptor	
	Child Resident	Adult Resident
Ingestion	1	0.4
Dermal Contact	0.05	0.02
Total HI	1	0.5

The HI values for residential potable use of the groundwater associated with monitoring well TWP-1 are 1 and 0.5 for child and adult residential receptors, respectively. These HI values do not exceed the USEPA threshold noncancer risk limit of an HI of 1 and indicate that groundwater would not pose a significant health risk for residential use. Potential risks to commercial/industrial workers would be less, consistent with the risk characterization of the SA 61Z SI report.

5.3 Summary and Conclusion

The cumulative noncancer risks (i.e., sum of risks for ingestion, dermal, and inhalation exposures to soil and groundwater combined) for the child and adult resident exposure scenarios do not exceed the USEPA threshold HI of 1. Cancer risks were not calculated because no potentially carcinogenic COPCs were identified. Therefore, the results of this PRE indicate that the subsurface soils and groundwater at SA 61Z do not pose a significant health risk for future unrestricted land use.

6.0 CONCLUSIONS

Upon consideration of the completed dry well, No. 2 Fuel Oil UST, waste oil UST removal actions; and the outcome of the groundwater and subsurface-soil risk evaluations; the site does not present an unacceptable threat to human health under the evaluated residential use scenario, or to the environment. No further action is recommended for groundwater and soil at the dry well, No. 2 Fuel Oil UST, and waste oil UST at SA 61Z.

Further evaluation of surface soil in the Building 202 unpaved parking lot component of SA 61Z is recommended for transfer to the Devens Soil Storage Facility Closeout activities, to be addressed upon removal of the contaminated soil stockpiles.

In accordance with CERCLA 120 (h)(3), the U.S. Army has taken all remedial actions currently required at the Building 202 dry well, No. 2 Fuel Oil UST, and waste oil UST at SA 61Z. Further, SA 61Z is suitable for unrestricted future use.

7.0 DECISION

Upon consideration of the completed dry well, No. 2 Fuel Oil UST, waste oil UST removal actions; and the outcome of the groundwater and subsurface-soil risk evaluations; SA 61Z does not present an unacceptable threat to human health under the evaluated residential use scenario, or to the environment. No further action is required for groundwater and soil at the dry well, No. 2 Fuel Oil UST, and waste oil UST at SA 61Z.

In accordance with CERCLA 120 (h)(3), the U.S. Army has taken all remedial actions currently required at the Building 202 dry well, No. 2 Fuel Oil UST, and waste oil UST at SA 61Z. SA 61Z is suitable for unrestricted future use.

Signature below by the U.S. Army, USEPA, and MADEP constitutes concurrence with the same and will remove SA 61Z from further consideration under the U.S. Army Installation Restoration Program and CERCLA. Further evaluation of surface soil in the Building 202 unpaved parking lot component of SA 61Z is administratively transferred to Devens Soil Storage Facility Closeout activities, to be addressed upon removal of the contaminated soil stockpiles.

U.S. DEPARTMENT OF THE ARMY

JAMES C. CHAMBERS
BRAC Environmental Coordinator
Devens Reserve Forces Training Area
Devens, Massachusetts

26 JAN 2000
Date

U.S. ENVIRONMENTAL PROTECTION AGENCY

01/26/2000
Date

JEROME C. KEEFE
Devens Remedial Project Manager
U.S. Environmental Protection Agency, New England

[✓] Concur

[ ] Nonconcur (Please provide reasons for nonconcurrence in writing)

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

1/26/00
Date

for ROBERT BOIS
Section Chief, Compliance and Enforcement - CERO
Massachusetts Department of Environmental Protection

[✓] Concur

[ ] Non-concur (Please provide reasons for non-concurrence in writing)

ABB-ES	ABB Environmental Services, Inc.
ADL	Arthur D. Little, Inc.
AOC	Area of Contamination
AREE	Area Requiring Environmental Evaluation
bgs	below ground surface
BRAC	Base Closure and Realignment
BTEX	benzene, toluene, ethylbenzene, and xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPC	chemical of potential concern
cy	cubic yard
EPC	exposure point concentration
EPH	extractable petroleum hydrocarbons
GC	gas chromatograph
GPR	ground penetrating radar
HI	hazard index
HLA	Harding Lawson Associates
IRA	Immediate Response Action
MADEP	Massachusetts Department of Environmental Protection
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MCP	Massachusetts Contingency Plan
MEP	Master Environmental Plan
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
NCEA	National Center for Environmental Assessment
NDIR	nondispersive infrared spectroscope
OHM	OHM Remediation Services Corp.
OVA	organic vapor analyzer
PAH	polynuclear aromatic hydrocarbon

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

PCBs	polychlorinated biphenyls
PID	photoionization detector
ppm	part per million
PRE	Preliminary Risk Evaluation
RAF	relative adsorption factor
RBC	risk based concentration
RCRA	Resource Conservation and Recovery Act
RFTA	Reserve Forces Training Area
RI	remedial investigation
SA	Study Area
SARA	Superfund Amendments and Reauthorization Act
SI	site investigation
SSE	supplemental site evaluation
SSI	supplemental site investigation
SVOC	semivolatile organic compound
TAL	Target Analyte List
TLC	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TOC	total organic carbon
TOV	total organic vapor
TPH	total petroleum hydrocarbons
USACE	U.S. Army Corps of Engineers
USAEC	U.S. Army Environmental Center
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
UST	underground storage tank
µg/kg	microgram per kilogram
µg/L	microgram per liter
VOC	volatile organic compound
VPH	volatile petroleum hydrocarbons
Weston	R. F. Weston, Inc.

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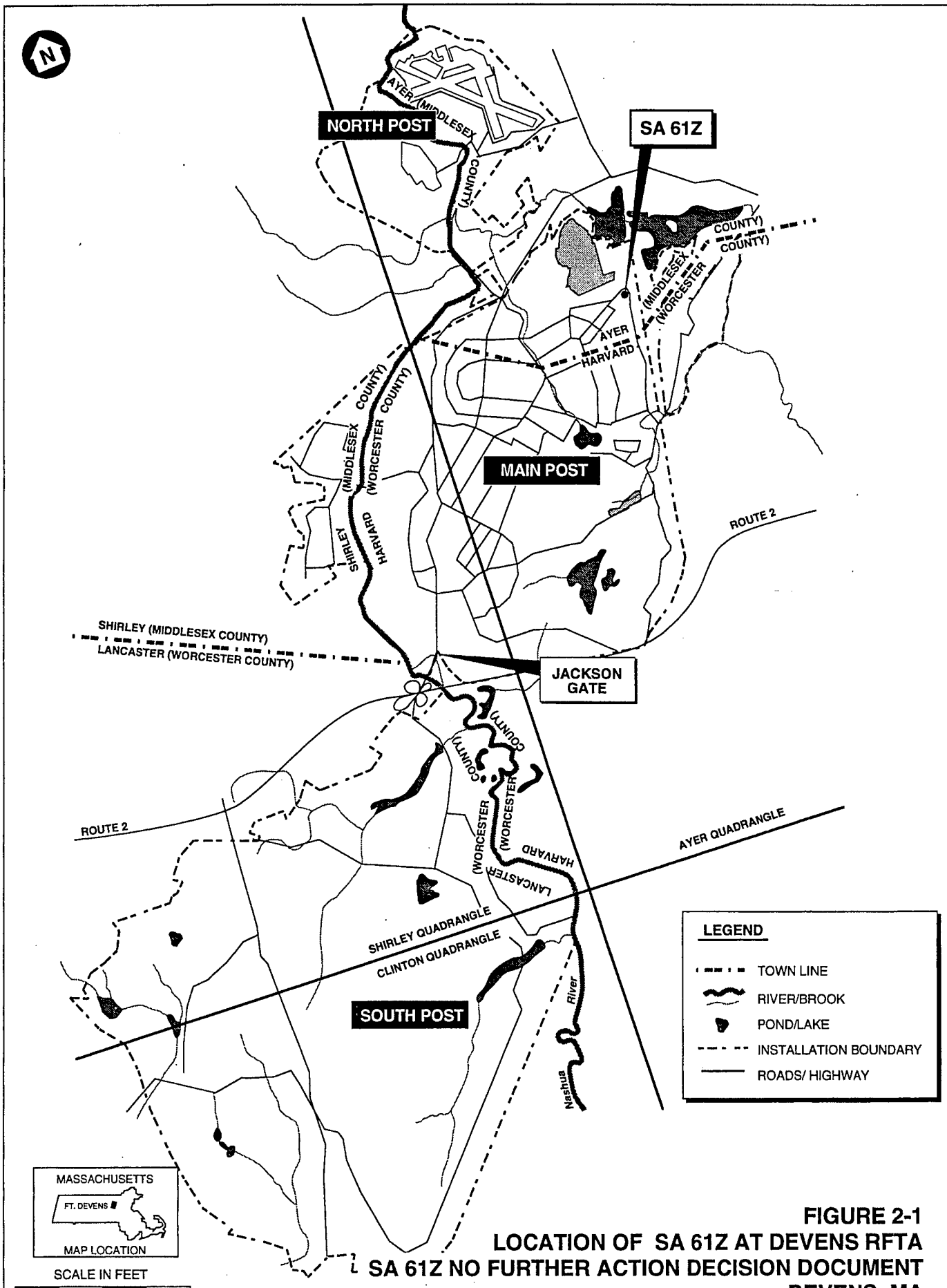

FIGURE 2-1
LOCATION OF SA 61Z AT DEVENS RFTA
SA 61Z NO FURTHER ACTION DECISION DOCUMENT
DEVENS, MA

Harding Lawson Associates

9906010 1

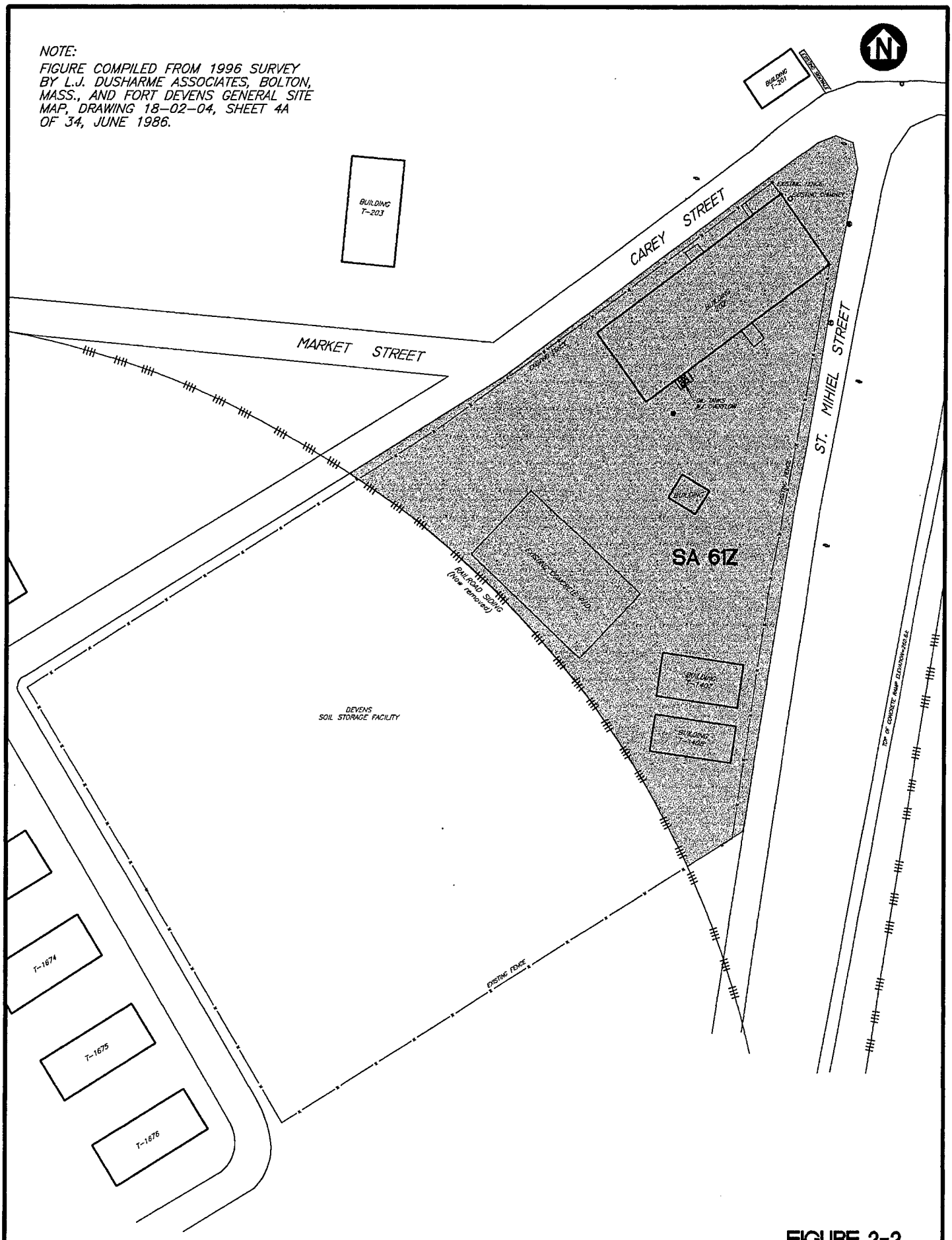

FIGURE 2-2
LOCATION OF SA 61Z
SA 61Z NO FURTHER ACTION DECISION DOCUMENT
DEVENS, MA
Harding Lawson Associates

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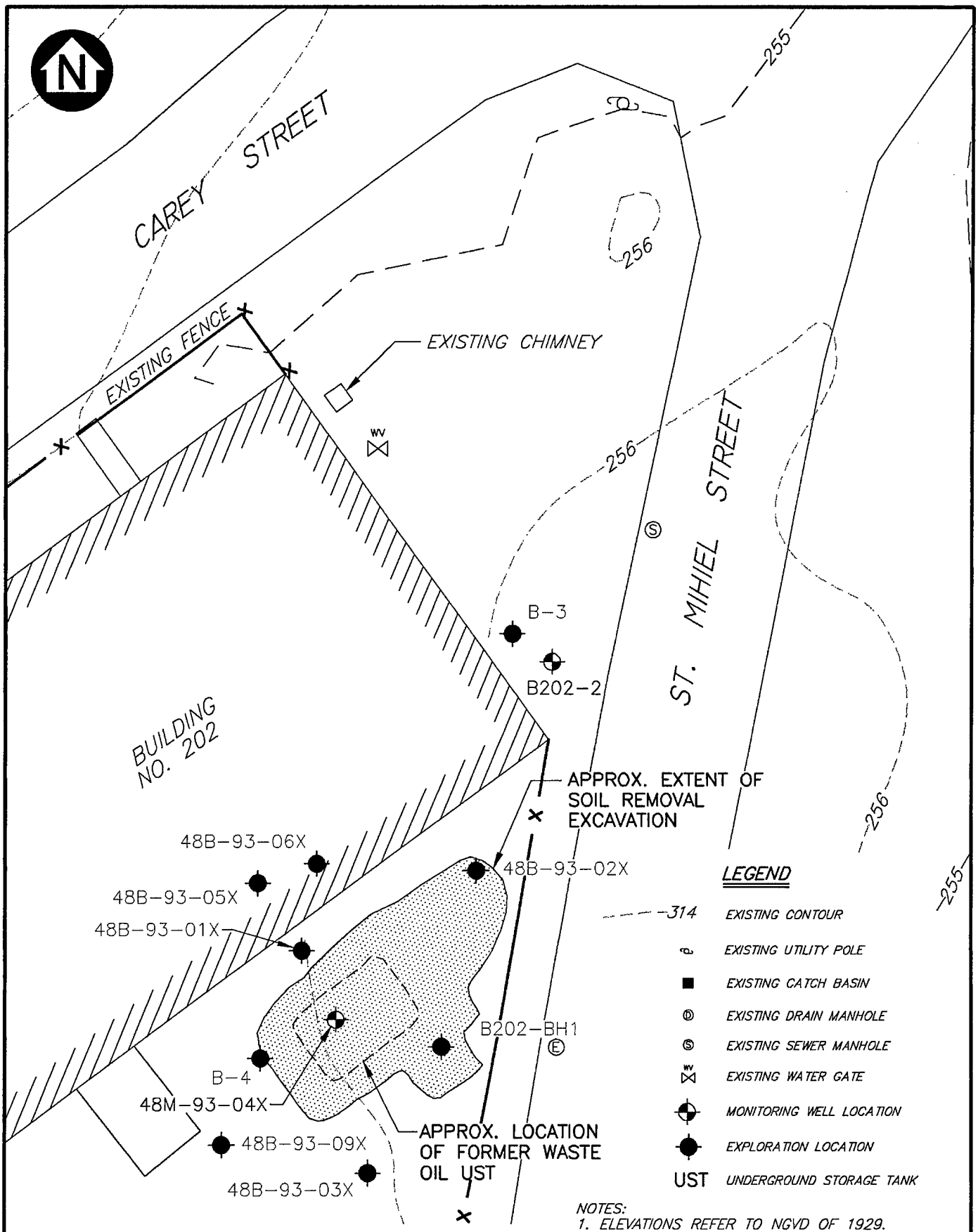

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FIGURE 3-1
SA 48 EXPLORATION LOCATIONS
SA 61Z NO FURTHER ACTION DECISION DOCUMENT
DEVENS, MA

Harding Lawson Associates

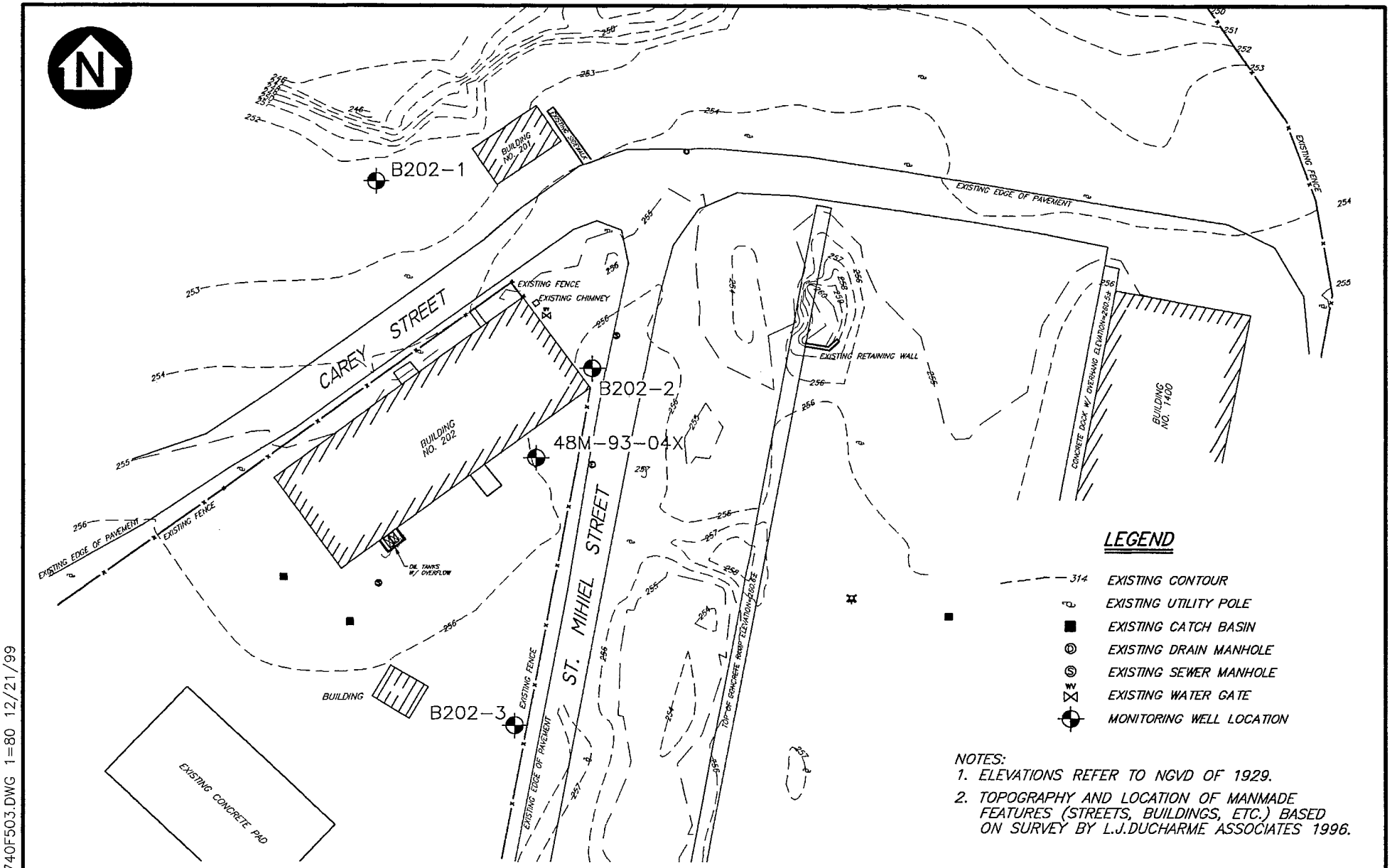

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FIGURE 3-2
SA 48 MONITORING WELL LOCATIONS
SA 61Z NO FURTHER ACTION DECISION DOCUMENT
DEVENS, MA

Harding Lawson Associates

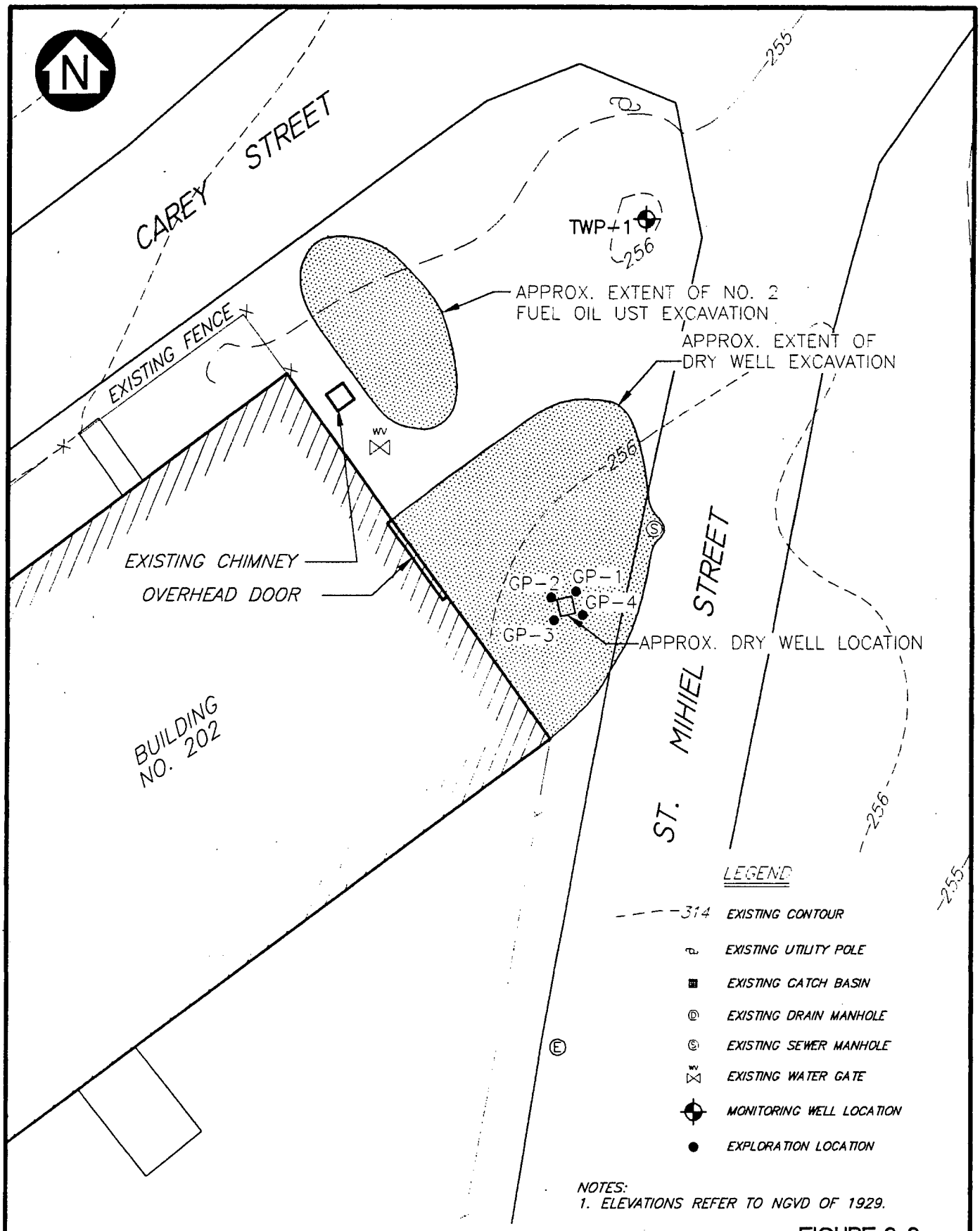

FIGURE 3-3
SA 61Z PREVIOUS INVESTIGATION AND EXPLORATION LOCATIONS
SA 61Z NO FURTHER ACTION DECISION DOCUMENT
DEVENS, MA

Harding Lawson Associates

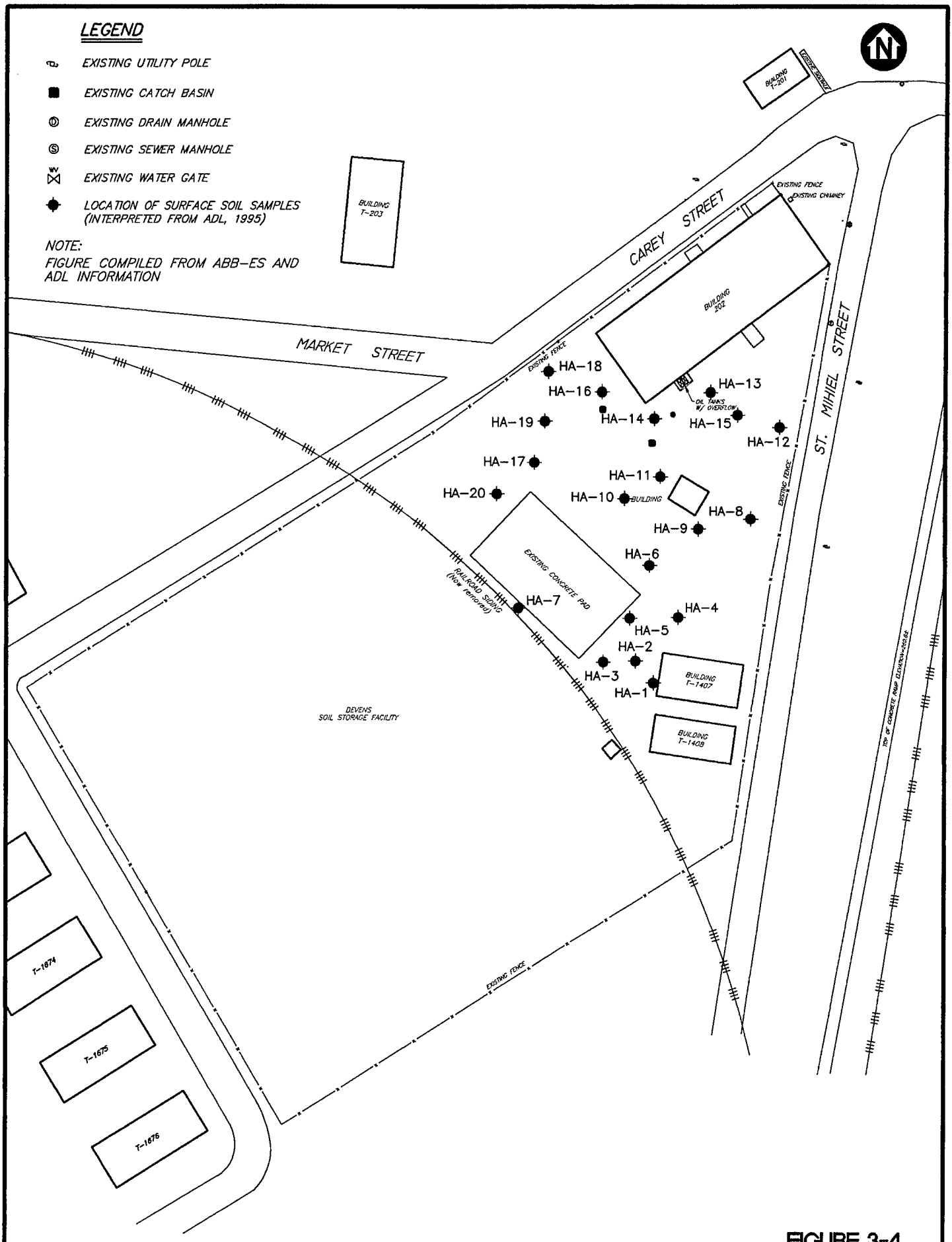

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FIGURE 3-4
LOCATION OF AREE 61Z SURFACE SOIL SAMPLES
SA 61Z NO FURTHER ACTION DECISION DOCUMENT
DEVENS, MA
Harding Lawson Associates

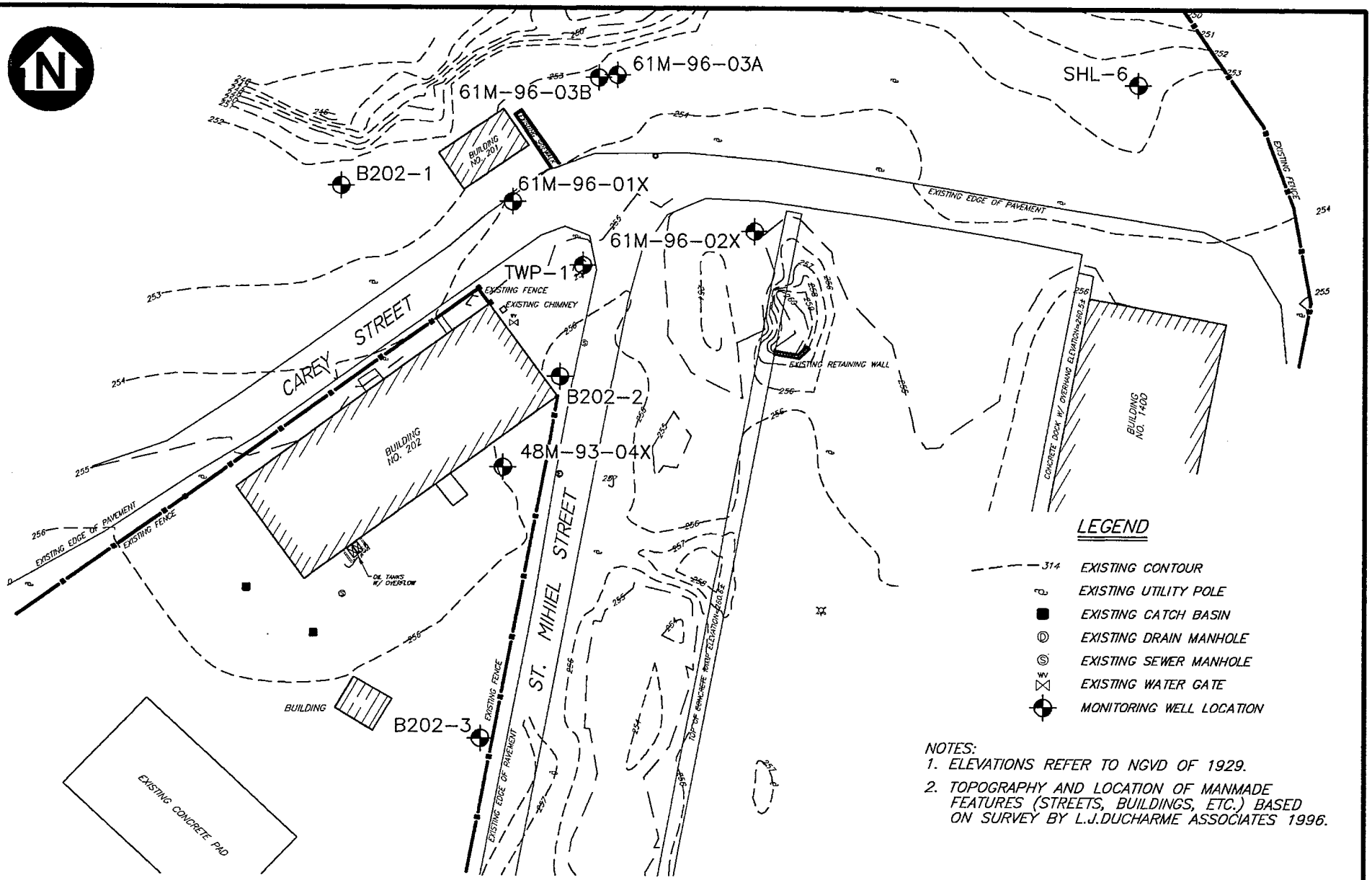

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FIGURE 3-5
SA 61Z MONITORING WELL LOCATIONS
SA 61Z NO FURTHER ACTION DECISION DOCUMENT
DEVENS, MA

Harding Lawson Associates

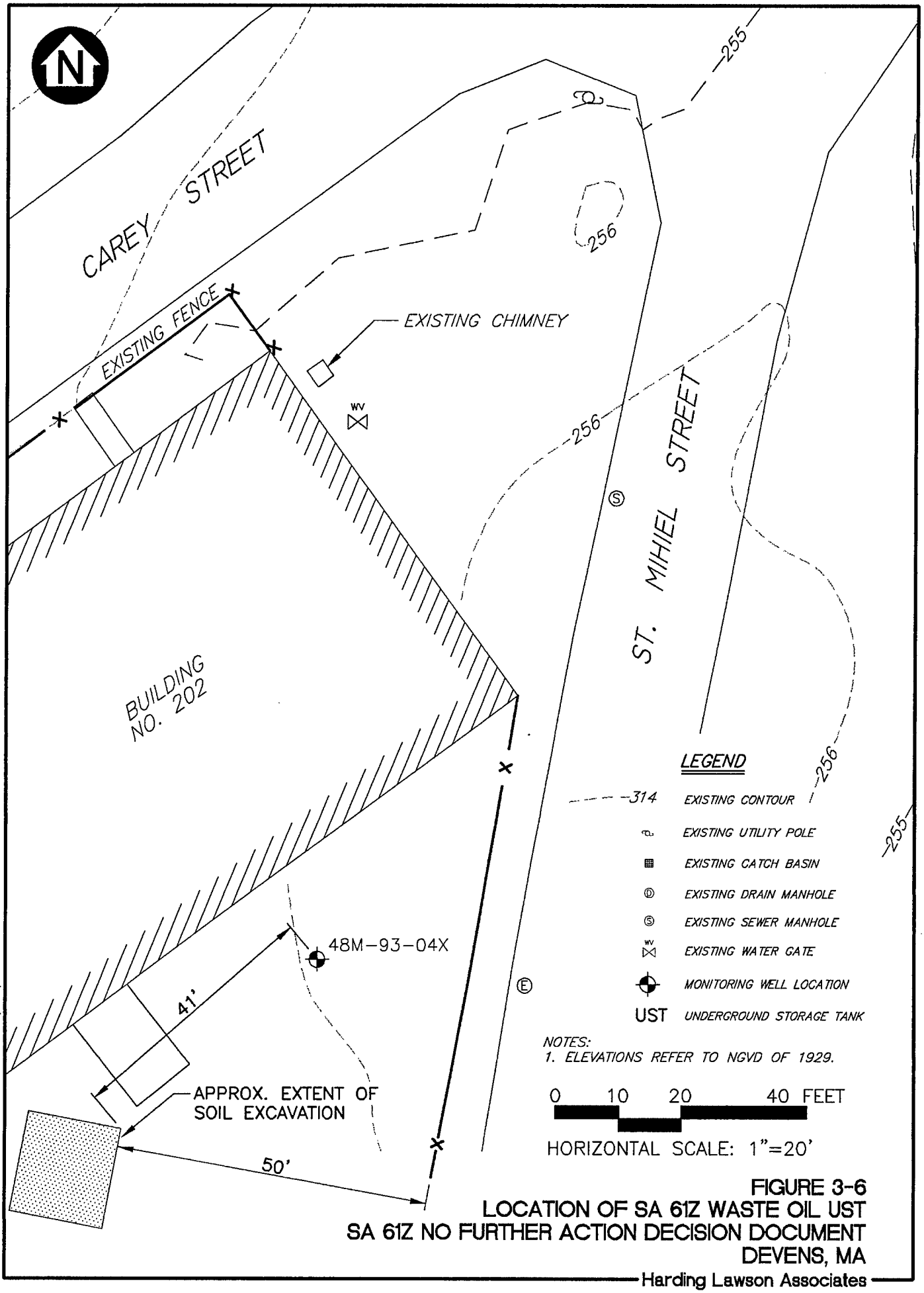

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FIGURE 3-6
LOCATION OF SA 61Z WASTE OIL UST
SA 61Z NO FURTHER ACTION DECISION DOCUMENT
DEVENS, MA

Harding Lawson Associates

CONSENSUS STATEMENT

TABLE 3-1
SUMMARY OF STUDY AREA 48 INVESTIGATION ACTIVITIES

SA 61Z NO FURTHER ACTION DECISION DOCUMENT
DEVENS, MA

MONTH/ YEAR	ACTIVITY	CONTRACTOR	NUMBER COMPLETED	EXPLORATION IDENTIFICATION	PURPOSE OF ACTIVITY
STUDY AREA 48 WASTE OIL UST REMOVAL					
FEBRUARY 1989	PULL 1,000-GAL WASTE OIL TANK	EE&G	1 TANK	NA	REMOVE POTENTIAL SOURCE OF SOIL AND GROUNDWATER CONTAMINATION
	SOIL REMOVAL	EE&G	100 CUBIC YARDS	NA	REMOVE CONTAMINATED SOILS ASSOCIATED WITH TANK PULL
	SOIL SAMPLES	EE&G	19	NA	FIELD SCREENING SAMPLES TO ASSESS IMPACT TO SUBSURFACE SOIL FROM WASTE OIL UST EXCAVATION PRIOR TO REMEDIATION
	SOIL SAMPLES	EE&G	2	NA	LAB ANALYTICAL SAMPLES TO ASSESS IMPACT TO SUBSURFACE SOIL FROM WASTE OIL UST EXCAVATION PRIOR TO REMEDIATION
MAY 1989	SOIL BORINGS	EE&G	2	B-3 AND B-4	FIELD SCREENING SAMPLES TO ASSESS IMPACT OF FORMER WASTE OIL UST ON SUBSURFACE SOIL
STUDY AREA 48 SITE INVESTIGATION					
JUNE/JULY 1991	SOIL BORING	E&E	1	B202-BH1	COLLECT SOIL SAMPLES CLOSE TO FORMER TANK LOCATION TO ASSESS RESIDUAL CONTAMINATION
	MONITORING WELL INSTALLATION	E&E	3 WELLS/SAMPLES	B202-1 TO B202-3	GROUNDWATER SAMPLING TO ASSESS POTENTIAL IMPACT TO GROUNDWATER FROM FORMER WASTE OIL TANK
	INSITU HYDRAULIC CONDUCTIVITY TESTING	E&E	3 WELLS	B202-1 TO B202-3	PERMEABILITY TO ESTIMATE AQUIFER HYDRAULIC CONDUCTIVITIES
STUDY AREA 48 SOIL REMOVAL ACTION					
APRIL/MAY 1993	SOIL REMOVAL	SITE REMEDIATION SERVICES, INC./E&E	132 TONS	NA	REMOVAL OF SUBSURFACE SOILS IMPACTED BY FORMER WASTE OIL UST
	SOIL SAMPLES	SITE REMEDIATION SERVICES, INC./E&E	35	NA	FIELD SCREENING SAMPLES TO ASSESS EXTENT OF IMPACTED SOIL TO BE REMOVED
	SOIL SAMPLES	E&E	4	48E-93-03X TO 43E-93-06X	TWO TCLP SAMPLES OF STOCKPILED SOILS FOR CHARACTERIZATION AND TWO SAMPLES FROM

TABLE 3-1
SUMMARY OF STUDY AREA 48 INVESTIGATION ACTIVITIES

SA 61Z NO FURTHER ACTION DECISION DOCUMENT
DEVENS, MA

MONTH/ YEAR	ACTIVITY	CONTRACTOR	NUMBER COMPLETED	EXPLORATION IDENTIFICATION	PURPOSE OF ACTIVITY
					EXCAVATION FOR LABORATORY ANALYSIS OF TPHC
NOVEMBER 1993	SOIL SAMPLES	WEBSTER ENGINEERING CO.	7	Xp01 TO Xp03 AND Xp07 TO Xp010	CHARACTERIZATION OF STOCKPILED SOILS PRIOR TO DISPOSAL
STUDY AREA 48 SUPPLEMENTAL SITE INVESTIGATION					
DECEMBER 1993	GEOPHYSICS SURVEY	ABB-ES	1 SURVEY	NA	GPR SURVEY TO LOCATE EXTENT OF FORMER EXCAVATION AND IDENTIFY SAFE DRILLING LOCATIONS
	SOIL BORINGS	ABB-ES	7	48B-93-01X TO 48B-93-06X AND 48B-93-09X	COLLECT SOIL SAMPLES IN AND AROUND FORMER TANK LOCATIONS FOR LABORATORY ANALYSIS
	SOIL BORING AND MONITORING WELL	ABB-ES	1	48M-93-04X	COLLECT SOIL SAMPLES FROM WITHIN THE TANK EXCAVATION FOR LABORATORY ANALYSIS AND INSTALL MONITORING WELL TO ASSESS IMPACT TO GROUNDWATER
JANUARY 1994	GROUNDWATER SAMPLING	ABB-ES	4 WELLS	B202-1 TO B202-3 AND 48M-93-04X	GROUNDWATER SAMPLING TO ASSESS POTENTIAL IMPACT FROM FORMER UST

TABLE 3-2
SUMMARY OF PREVIOUS STUDY AREA 61Z INVESTIGATION ACTIVITIES

SA 61Z NO FURTHER ACTION DECISION DOCUMENT
DEVENS, MA

MONTH/ YEAR	ACTIVITY	CONTRACTOR	NUMBER COMPLETED	EXPLORATION IDENTIFICATION	PURPOSE OF ACTIVITY
AREE 61Z SUPPLEMENTAL SITE EVALUATION					
MAY 1994	GEOPHYSICS SURVEY	ADL	1 SURVEY	NA	GPR SURVEY TO LOCATE DRY WELL AND IDENTIFY SAFE DRILLING LOCATIONS
	GEOPROBE BORINGS	ADL	4 BORINGS	GP-1 TO GP-4	COLLECT SOIL SAMPLES TO ASSESS IMPACT TO SUBSURFACE SOIL FROM DRY WELL FOR FIELD SCREENING AND LABORATORY ANALYSIS
	SURFACE SOIL SAMPLES	ADL	20 SAMPLES	HA-1 TO HA-20	COLLECT SURFACE SOIL SAMPLES FROM THE UNPAVED LOT ADJACENT TO 202 TO ASSESS POTENTIAL SOIL CONTAMINATION FOR FIELD SCREENING AND LABORATORY ANALYSIS
DRY WELL REMOVAL PROGRAM					
MARCH 1995	DRY WELL REMOVAL	OHM	1 DRY WELL	NA	REMOVE A SOURCE OF POTENTIAL SOIL AND GROUNDWATER CONTAMINATION
	SOIL SAMPLES	OHM	73 SAMPLES	NA	SAMPLES FROM DRY WELL EXCAVATION FOR FIELD SCREENING AND LABORATORY ANALYSIS
	TEMPORARY WELL POINT INSTALLATION AND GROUNDWATER SAMPLING	OHM	1 WELL POINT	TWP-1	COLLECT TWO ROUNDS OF GROUNDWATER SAMPLES FOR LABORATORY ANALYSIS TO ASSESS IMPACT OF DRY WELL ON GROUNDWATER
AOC 61Z NO. 2 FUEL OIL UST REMOVAL ACTION					
JUNE 1996	REMOVAL 5,000-GAL FUEL OIL TANK	WESTON	1 TANK	NA	REMOVE A SOURCE OF POTENTIAL SOIL AND GROUNDWATER CONTAMINATION
	SOIL SAMPLING	WESTON	8 SAMPLES	N-1, N-2, S-2, E-1, W-1, B-1 T0 B-3	TPH FIELD SCREENING TO ASSESS EXTENT OF SOIL CONTAMINATION ASSOCIATED WITH UST
	SOIL SAMPLING	WESTON	7 SAMPLES	61Z-E100 TO 61Z-E106	CONFIRMATORY COMPOSITE SOIL SAMPLES FROM UST EXCAVATION FOR LABORATORY ANALYSIS

TABLE 3-3
SUMMARY OF STUDY AREA 48 SOIL BORINGS

SA 61Z NO FURTHER ACTION DECISION DOCUMENT
DEVENS, MA

EXPLORATION ID	COMPLETION DEPTH (feet bgs)	REFERENCE SAMPLE INTERVALS (feet bgs)	OFF-SITE LABORATORY ANALYTICAL SAMPLES COLLECTED	SOIL TYPE (USCS)	TOTAL VOCs BY PID (ppm)	COMMENTS
STUDY AREA 48 WASTE OIL UST REMOVAL						
B-3	32	0-2		SP	0	
		5-7		SP	0.2	
		10-12		SP	0.1	
		12-14		SP	0.1	
		14-16		SP	0.1	
		16-18		SM	0	
		18-20		SM	150	
		20-22		SP-SM	0.2	
		22-24		SP-SM	0.2	
		24-26		SM	0.1	
		26-28		SM	0.2	
		28-30		SP-SM	0.3	
		30-32		SP-SM	0.2	
B-4	32	0-2		SP	0.4	
		5-7		SP	0.3	
		10-12		SP	0.2	
		12-14		SM	0	
		14-16		SM	0	
		16-18		SM	0.1	
		18-20		SP	0	
		20-22		SP	0	
		22-24		SP	0	
		24-26		SP	0.1	
		26-28		SP	0.5	
		28-30		SP	0.2	
		30-32		SM	0	
STUDY AREA 48 SITE INVESTIGATION						
B202-BH1	36	0-2	0-2	SP	0.1	
		5-7	5-7	SP	0	
		10-12	10-12	SP	0	
		18-20	18-20	SP	0	
		20-22	20-22	SP	0	
		25-27	25-27	SP	0	
		30-32	30-32	SP	0	
		34-36		SP	0	
B202-1	35	0-2		GP, SW	0	ROAD GRAVEL TO 1.0 FEET
		5-7		SP	0.2	
		10-12		SW	0	
		15-17		SP	0	
		20-22		SP	0	
		25-27		SP	0	
		30-32		SP	0	
B202-2	40	0-2		SW	0.2	
		5-7		SP	0	
		10-12		SP	1.6	
		15-17		SP	0.8	
		20-22		SP	1	
		25-27		SW	0.6	
		30-32		SP	0.4	
B202-3	40	0-2		SM	3.3	
		5-7		SP	1.4	
		10-12		SP	1.4	
		15-17		SP	1	
		20-22		SP	1	
		25-27		SW	0.8	
		30-32		SW	2.6	

TABLE 3-3
SUMMARY OF STUDY AREA 48 SOIL BORINGS

SA 61Z NO FURTHER ACTION DECISION DOCUMENT
DEVENS, MA

EXPLORATION ID	COMPLETION DEPTH (feet bgs)	REFERENCE SAMPLE INTERVALS (feet bgs)	OFF-SITE LABORATORY ANALYTICAL SAMPLES COLLECTED	SOIL TYPE (USCS)[1]	TOTAL VOCs BY PID (ppm)	COMMENTS
STUDY AREA 48 SUPPLEMENTAL SITE INVESTIGATION						
48B-93-01X	32	5-7		SW	0.7	
		10-12		SW	0.7	
		15-17	15-17	SP	0.7	
		20-22		SW	0.7	
		25-27		SW	0.7	
		30-32		SP	0.7	
48B-93-02X	32	5-7		SP	0	
		10-12		SP	0	
		15-17		SP	0.7	
		20-22	20-22	SP	0.7	
		25-27		SP	0.7	
		30-32		SP	0.7	
48B-93-03X	32	5-7		SP	0	
		10-12		SP	0	
		15-17		SP	0	
		20-22		SP	0	
		25-27		SP	0	
		30-32	30-32	SP	0	
48B-93-04X	42	15-17	15-17	SW	1.2	PIECE OF PLASTIC SHEETING
		20-22		SW	0.7	
		25-27		SW	0.7	
		30-32		SP	0.7	
		35-37		SP	0.2	
		40-42		SP	0.2	
48B-93-05X	32	5-7		SP	0	
		10-12		SP	3.5	
		15-17	15-17	SP	6.3	
		20-22		SP	6.3	
		25-27		SW	5.4	
		30-32		SP	4	
48B-93-06X	32	5-7		SP	0.2	
		10-12		SP	0.2	
		15-17		SP,SW	1.7	
		20-22		SP	1.2	
		25-27		SW	0.2	
		30-32	30-32	SP	1.7	
48B-93-09X	32	5-7		SP	0	
		10-12		SW	0	
		15-17		SP	0	
		20-22		SP	0	
		25-27		SP	0	
		30-32	30-32	SW	0	

NOTES:

[1] USCS type determined from field sample by on-site geologist during sampling.
Soil classification mode from grain size distribution analyses may vary from field classification.

bgs = below ground surface
BKG = Background levels of total VOCs, measured with a PID in the field
PHYL = phyllite
PID = Photoionization Detector
ppm = parts per million
USCS = Unified Soil Classification System
VOCs = Volatile Organic Compounds

TABLE 3-4
SUMMARY OF STUDY AREA 48 SI GROUNDWATER MONITORING DATA

SA 61Z NO FURTHER ACTION DECISION DOCUMENT
DEVENS, MA

Site ID.:		B202-1		B202-1		B202-1		B202-2		B202-2		B202-3		B202-3		B202-3	
Field Sample Number:		B202-1		B202-1		B2021DUP		B202-2		B202-2		B202-3		B202-3		B202-4	
Date:		12/11/91		7/23/91		7/23/91		12/11/91		7/23/91		12/11/91		7/23/91		7/23/91	
Units:		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
EXPLOSIVES																	
Cyclonite / Hexogen / RDX	<	.617		NA		NA		.563	1	NA		2.96		NA		NA	
METALS																	
Aluminum		7700		14000		14000		1570		4400		210000		11000		10000	
				13000	D	13000	D										
Arsenic		33		110		110		10.3		34		1500		150		130	
Barium		68		120		120		24.7		40.6	8	950		62		52	
Beryllium	<	.341		.573		.573	<	.341	<	.341		7.5		.545		.558	
Cadmium	<	2.67		7.78		7.78	<	2.67	<	2.67	<	27	K	2.67		4.16	
Calcium		19000		16000		16000		10000		12000	8	51000		12000		12000	
Chromium		9.68		30.3		30.3	<	4.47		6.99		490		23.1		21.5	
Copper		23.3		43.5		43.5	<	4.29		13.9		730		41.3		39.3	
Iron		12000		23000		23000		3200		7800		50000		24000		22000	
Lead		14.2		37		37	<	4.74		14		400		42.8		35.8	
Magnesium		4400		6700		6700		1600		2400		50000		5600	8	5000	
Manganese		2700		4200		4200		80.1		206	8	14000		1200		1000	
Nickel		23.1		58.8		58.8	<	8.76	<	8.76		480		31.8		32.2	
Potassium		5500	T	5000	T	5000	T	1840	T	2310	T	49000	T	2740	T	2610	T
Silver	<	.316		.316	<	.316	<	.316	<	.316		1.2	<	.316	<	.316	
Sodium		150000	T	33000	T	33000	T	150000	T	27000	T	18000	T	15000	T	15000	T
Vanadium		7.88		24.1		24.1	<	4		8.04		400		18.8		20.2	
Zinc		80.2		84.2		84.2		37.3		37.4		1000		57.8		57.9	
PESTICIDES/PCBS																	
Aldrin		.05	T	.05	T	.05	T	.05	T	.05	T	.0654	U	.05	T	.05	T
VOLATILE ORGANICS																	
Chloroform	<	.83		.83		NA		.77	1	.83	<	.83	<	.83	<	.83	
Dichloromethane		4.3	1	6.9		NA		5.3		7.8		4.1	1	6.8		6.8	
Trichloroethylene		1.3	<	7		NA	<	.5	<	7	<	.5	<	7	<	7	
WET CHEMISTRY																	
Alkalinity		32000		NA		NA		16000		NA		12000		NA		NA	
Chloride		49000		57000		57000		29000	1	54000		7400		13000		8300	
Nitrate		1700		2200		2200		2100		2000		4000		4400		4500	
Nitrogen By Kjeldahl Method		111		NA		NA		117		NA		193		NA		NA	
Sulfate		16000		19000		19000		18000		20000		21000		25000		22000	
Total Hardness		NA		63000		63000		NA		36500		NA		48900		46800	

NOTES:

< = less than
DUP = duplicate
N/A = not analyzed
T = unfiltered
µg/L = micrograms per liter

TABLE 3-5
SUMMARY OF STUDY AREA 48 SUPPLEMENTAL SITE INVESTIGATION
SUBSURFACE SOIL SAMPLE ANALYSIS

SA 61Z NO FURTHER ACTION DECISION DOCUMENT
DEVENS, MA

BORING / SAMPLE ID / ANALYTE / DEPTH	48B-93-01X BX480115 15 FT	48B-93-01X BX481115 15 FT DUP	48B-93-02X BX480220 20 FT	48B-93-03X BX480330 30 FT	48M-93-04X BX480415 15 FT	48B-93-05X BX480515 15 FT	48B-93-06X BX480630 ^30 FT	48B-93-09X BX480930 ^30 FT
VOLATILE ORGANICS (µg/kg dry wt)								
1,1,1-TRICHLOROETHANE	3 J	< 6	1 J	< 6	< 6	< 6	4 J	< 6
METHYLENE CHLORIDE	< 12	6 JB	< 11	4 JB	< 11	< 11	< 12	5 JB
1,1,2,2-TETRACHLOROETHANE	< 6	4 J	< 6	< 6	< 6	< 6	< 6	< 6
SEMIVOLATILE ORGANICS (µg/kg dry wt)								
DI-N-BUTYL PHTHALATE	130 J	76 J	180 J	200 JB	100 J	81 J	99 J	140 JB
BIS(2-ETHYLHEXYL)PHTHALATE	< 400	360 J	< 360	< 400	190 J	< 360	49 J	< 400
BUTYL BENZYLPHTHALATE	< 400	< 360	< 360	< 400	210 J	< 360	< 400	< 400
DIETHYLPHTHALATE	< 400	< 360	< 360	< 400	< 360	< 360	< 400	< 400
OTHER (mg/kg dry wt)								
TOTAL PETROLEUM HYDROCARBONS	90	110	< 25	< 25	180	< 25	< 25	< 25

Notes:
B Flag denotes detection of the analyte in the laboratory method blank analyzed concurrently with the sample.
Dup = duplicate
FT = feet
J Flag denotes an estimated value less than the laboratory's Practical Quantitation Limit.
< Indicates analyte not detected above sample quantitation limit.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
wt = weight

TABLE 3-6
SUMMARY OF STUDY AREA 48 SSI
GROUNDWATER SAMPLE ANALYSIS

SA 61Z NO FURTHER ACTION DECISION DOCUMENT
DEVENS, MA

ANALYTE	WELL SAMPLE ID BACKGROUND	B202-1 MX4801X1 FILTERED	B202-1 MX4801X1 UNFILTERED	B202-2 MX4802X1 FILTERED	B202-2 MX4802X1 UNFILTERED	B202-3 MX4803X1 FILTERED	B202-3 MX4803X1 UNFILTERED	48M-93-04X MX4804X1 FILTERED	48M-93-04X MX4804X1 UNFILTERED	48M-93-04X MX4811X1 DUP FILTERED	48M-93-04X MX4811X1 DUP UNFILTERED
VOLATILE ORGANICS (µg/L)											
1,1,1-TRICHLOROETHANE		NA	1 JB	NA	< 5	NA	1 JB	NA	< 5	NA	1 JB
METHYLENE CHLORIDE		NA	2 JB	NA	< 10	NA	3 JB	NA	3 JB	NA	3 JB
TRICHLOROETHENE		NA	3 J	NA	< 5	NA	< 5	NA	< 5	NA	< 5
SEMIVOLATILE ORGANICS (µg/L)											
PHENOL		NA	17	NA	11	NA	12	NA	5 J	NA	5 J
BIS(2-ETHYLHEXYL)PHTHALATE		NA	< 10	NA	< 10	NA	2 J	NA	4 J	NA	1 J
CHRYSENE		NA	< 10	NA	< 10	NA	8 J	NA	< 10	NA	< 11
METALS (µg/L)											
ALUMINUM	6870	< 100	< 100	< 100	< 100	< 100	130	< 100	100	< 100	110
BARIUM	39.6	9	10	7	9	5	< 5	< 5	5	< 5	< 5
CALCIUM	14700	14000	14000	11000	11000	19000	17000	9000	9000	8400	8600
IRON	9100	< 25	< 25	< 25	28	< 25	< 25	< 25	< 25	< 25	< 25
MAGNESIUM	3480	1800	1800	1400	1400	2200	1900	1100	1100	1000	1100
MANGANESE	291	< 5	< 5	< 5	< 5	18	15	23	21	28	17
NICKEL	34.3	< 40	42	< 40	< 40	< 40	< 40	< 40	< 40	< 40	< 40
POTASSIUM	2370	1200	1900	1100	1200	1100	1400	1500	1600	1200	1100
SODIUM	10800	31000	32000	19000	19000	14000	10000	17000	16000	18000	15000
OTHER (mg/L)											
TOTAL PETROLEUM HYDROCARBONS		NA	< 1.3	NA	< 1.2	NA	< 1.3	NA	< 1.1	NA	< 1

Notes:

< Indicates analyte not detected above sample quantitation limit shown.
B Flag denotes detection of the analyte in the laboratory method blank analyzed concurrently with the sample.
J Flag denotes an estimated value less than the laboratory's Practical Quantitation Level.
mg/L = milligrams per liter
NA = Not analyzed
µg/L = micrograms per liter

TABLE 3-7
SUMMARY OF STUDY AREA 61Z SSE FIELD SCREENING DATA

SA 61Z NO FURTHER ACTION DECISION DOCUMENT
DEVENS, MA

SAMPLE POINT	DEPTH, (ft, bgs)	TPHC (ppm)	
HA-1	0-1	673	Resampled for off-site analysis
HA-1 (Duplicate)	0-1	616	
HA-2	0-1	1050	Resampled for off-site analysis
HA-3	0-1	1388	Resampled for off-site analysis
HA-4	0-1	39	
HA-5	0-1	18	
HA-6	0-1	50	
HA-6 (Duplicate)	0-1	51	
HA-7	0-1	114	
HA-8	0-1	88	
HA-9	0-1	114	
HA-10	0-1	190	
HA-11	0-1	630	Resampled for off-site analysis
HA-12	0-1	170	
HA-13	0-1	1195	Resampled for off-site analysis
HA-14	0-1	204	
HA-15	0-1	105	
HA-16	0-1	389	Resampled for off-site analysis
HA-17	0-1	118	
HA-18	0-1	421	Resampled for off-site analysis
HA-19	0-1	57	
HA-20	0-1	187	
HA-20 (Duplicate)	0-1	171	

NOTES:
Screening for TPHC performed in field laboratory using Nondispersive Infrared Analysis
Screening for benzene, toluene, ethylbenzene, and xylene (BTEX) by GC. No BTEX detected.
TPHC = total petroleum hydrocarbons
ppm = parts per million

TABLE 3-8
SUMMARY OF STUDY AREA 61Z UNPAVED PARKING LOT MONITORING DATA

SA 61Z NO FURTHER ACTION DECISION DOCUMENT
DEVENS, MA

Site ID.:	61Z--94-01		61Z--94-02		61Z--94-03		61Z--94-04		61Z--94-05		61Z--94-06		61Z--94-07	
Location:	HA-3		HA-13		HA-2		HA-1		HA-11		HA-18		HA-16	
Date:	04/04/94		04/04/94		04/04/94		04/04/94		04/04/94		04/04/94		04/04/94	
Units:	UGG		UGG		UGG		UGG		UGG		UGG		UGG	
METALS														
Aluminum	10500		9460		11200		11100		13400		7160		9950	
Arsenic	16		8.65		9.51		9.38		13.1		11.7		10.8	
Barium	32.8		31.6		31.8		39.8		40.1		23.2		40.2	
Boron	15.6	B7 JR	10.3	B7 JR	9.12	<	6.64	B7 JR <	6.64	B7 JR <	6.64	B7 JR <	6.64	B7 JR
Calcium	2210		1090		9460		3070		8430		1990		2060	
Chromium	27.5		17.9		15.5		31.4		22.3		16.8		23.7	
Cobalt	5.43		5.32		7.54		6.81		10		4.69		4.41	
Copper	10.7		12.5		7.86		10.6		21.5		11.2		17.6	
Iron	18300		15700		17200		21300		26700		15600		19300	
Lead	12.8		9.28		15		10.5		24		22.1		100	
Magnesium	4630		3530		4860		6290		5460		2580		5200	
Manganese	223		169		200		263		414		209		207	
Nickel	18.2		12.8		11		16.5		24.9		17.7		63.2	
Potassium	1670		2570		510		4040		1730		912		1910	
Sodium	139		136	<			145		63.4		70.5		148	
Tin	< 7.43		< 7.43	<	7.43		8.88	<	7.43	<	7.43	<	7.43	
Vanadium	26.2		17.1		30.3		30		36.3		27.3		174	
Zinc	37.3		53.9	<			42.7		57.1		35.7		80.3	
SEMIVOLATILE ORGANICS														
2-methylnaphthalene	1.2		< .032		0.79	<	.032		1.6		< .032		.15	
4-methylphenol	.53		< .24	<	.24	<	.24	<	.24	<	.24	<	.24	
Acenaphthene	3.4		.092		2.4		.11		4.8		.3		.28	
Acenaphthylene	13		.3		9.7		.43		30		.82		.56	
Anthracene	3.6		< .71		20	<	.71		50		< .71	<	.71	
Benzo[a]anthracene	50		.13	<			.2		100		.45		1.2	
Benzo[a]pyrene	50		< 1.2	<	1.2	<	1.2		100		< 1.2	<	1.2	
Benzo[b]fluoranthene	60		< .31	<	.31	<	.31		100		< .31		1.3	
Benzo[ghi]perylene	8		< .18		19	<	.18		70		< .18		.93	
Benzo[k]fluoranthene	70		< .13	<	.13	<	.13		90		.55		1.4	
Chrysene	60		.18	<			.23		100		.49		1.5	
Dibenz[ah]anthracene	9		< .31	<	.31	<	.31		20		< .31	<	.31	
Dibenzofuran	2.6		< .38		1.6	<	.38		5.1		< .38	<	.38	
Fluoranthene	50		.12		40		.14		100		.55		1.5	
Fluorene	9.4		< .065		6.4	<	.065		12		.18		.18	
Indeno[1,2,3-c,d]pyrene	30		< 2.4	<	2.4	<	2.4		50		< 2.4	<	2.4	
Naphthalene	3.5		< .74		1.8	<	.74		4		< .74	<	.74	
Phenanthrene	6.6		.18		40		.2		100		.55		1.2	
Pyrene	100		.24		100		.35		200		.91		2.6	
VOLATILE ORGANICS														
Trichloroethylene	< .23		< .23	<	.23	<	.23	<	.23	<	.23		1.3	
OTHER														
Total Organic Carbon	19900		5470		13000		6710		12500		7360		21000	
Total Petroleum Hydrocarbons	667		268		610		408		477		174		198	

NOTES:

J = Flag denotes an estimated value less than the laboratory's Practical Quantitation Level.
UGG = micrograms per gram

TABLE 3-9
SUMMARY OF STUDY AREA 61Z REMEDIAL INVESTIGATION ACTIVITIES

SA 61Z NO FURTHER ACTION DECISION DOCUMENT
DEVENS, MA

MONTH/ YEAR	ACTIVITY	CONTRACTOR	NUMBER COMPLETED	EXPLORATION IDENTIFICATION	PURPOSE OF ACTIVITY
AOC 61Z REMEDIAL INVESTIGATION					
JUNE 1996	GEOPHYSICS SURVEY	ABB-ES	1 SURVEY	NA	GPR AND MAGNETOMETER SURVEY TO IDENTIFY SAFE DRILLING LOCATIONS
	MONITORING WELL INSTALLATION	ABB-ES	4 WELLS	61M-96-01X TO 61M-96-03B	INSTALL MONITORING WELLS TO ASSESS POTENTIAL IMPACT TO GROUNDWATER FROM FORMER DRY WELL
JULY 1996	GROUNDWATER SAMPLING	ABB-ES	6 WELLS	61M-96-01X TO 61M-96-03B, TWP-1, AND B202-3	GROUNDWATER SAMPLING TO ASSESS POTENTIAL IMPACT TO GROUNDWATER FROM FORMER DRY WELL
OCTOBER 1996	GROUNDWATER SAMPLING	ABB-ES	6 WELLS	61M-96-01X TO 61M-96-03B, TWP-1, AND B202-3	GROUNDWATER SAMPLING TO ASSESS POTENTIAL IMPACT TO GROUNDWATER FROM FORMER DRY WELL
DECEMBER 1996	INSITU HYDRAULIC CONDUCTIVITY TESTING	ABB-ES	8 WELLS	B202-1 TO B202-3 61M-96-01X TO 61M-96-03B 48M-93-04X	PERMEABILITY TO ESTIMATE AQUIFER HYDRAULIC CONDUCTIVITIES

TABLE 3-10
SOIL SAMPLE CONFIRMATION ANALYSIS FOR EPH/VPH

SA 61Z NO FURTHER ACTION DECISION DOCUMENT
DEVENS, MA

Analyte	Units	61M-96-01X BX610127	61M-96-02X BX610225	61M-96-03A BX613A25	61M-96-03A BD613A25	61M-96-03 BX613B27
Target Volatile Organic Compounds	ug/kg	BRL	BRL	BRL	BRL	BRL
n-C 5 to n-C 8 Aliphatics		BRL	BRL	BRL	BRL	BRL
n-C 9 to n-C 12 Aliphatics		BRL	BRL	BRL	420	BRL
n-C 9 to n-C 10 Aromatics		BRL	BRL	BRL	BRL	BRL
Total n-C5 to n-C12 VPH		BRL	BRL	BRL	420	BRL
Target Extractable Organic Compounds	mg/kg	BRL	BRL	BRL	BRL	BRL
n-C 9 to n-C 18 Aliphatics		BRL	BRL	BRL	BRL	BRL
n-C 19 to n-C 36 Aliphatics		BRL	BRL	BRL	BRL	BRL
n-C 10 to n-C 22 Aromatics		BRL	BRL	BRL	BRL	BRL
Total n-C 9 to n-C 36 EPH		BRL	BRL	BRL	BRL	BRL

Notes:
VPH = volatile petroleum hydrocarbons
EPH = extractable petroleum hydrocarbons
BRL = below reporting limit
ug/kg = micrograms per kilogram
mg/kg= milligrams per kilogram

TABLE 3-11
REMEDIAL INVESTIGATION GROUNDWATER DATA SUMMARY FOR TPH
SA 61Z

SA 61Z NO FURTHER ACTION DECISION DOCUMENT
DEVENS, MA

	Round 1	Round 2	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Analyte	**61M-96-01X MX6101X1 07/31/96**	**61M-96-01X MD6101X2 10/31/96**	**61M-96-01X MX6101X2 10/31/96**	**61M-96-02X MX6102X1 07/31/96**	**61M-96-02X MX6102X2 11/01/96**	**61M-96-03A MX6103A1 07/31/96**	**61M-96-03A MX6103A2 10/31/96**	**61M-96-03B MX6103B1 07/31/96**	**61M-96-03B MX6103B2 10/31/96**	**B202-3 MX2023X1 07/31/96**	**B202-3 MX2023X2 11/01/96**	**TWP-1 MXTWP1X1 07/31/96**	**TWP-1 MXTWP1X2 10/31/96**
T. Petroleum Hydrocarbons, 418.1, µg/L	954	LT 174	LT 174	LT 178	LT 174	LT 181	LT 171	LT 169	LT 174	LT 192	LT 169	5200	347
VPH, MADEP Health Based Method													
Target Volatile Organic Compounds	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
n-C 5 to n-C 8 Aliphatics, µg/L	BRL	9	11	BRL	BRL	BRL	21	BRL	8	BRL	9	BRL	6
n-C 9 to n-C 12 Aliphatics, µg/L	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
n-C 9 to n-C 10 Aromatics, µg/L	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Total n-C 5 to n-C 12 VPH, µg/L	BRL	9	11	BRL	BRL	BRL	21	BRL	8	BRL	9	BRL	6
EPH, MADEP Health Based Method													
Target Extractable Organic Compounds	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
n-C 9 to n-C 18 Aliphatics, µg/L	620	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	560	BRL
n-C 19 to n-C 36 Aliphatics, µg/L	2100	BRL	BRL	710	BRL	530	BRL	BRL	BRL	BRL	BRL	5000	BRL
n-C 10 to n-C 22 Aromatics, µg/L	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL	990	BRL
Total n-C 9 to n-C 36 EPH, µg/L	2720	BRL	BRL	710	BRL	530	BRL	BRL	BRL	BRL	BRL	6550	BRL

Notes:
BRL = below reporting limit
EPH = extractable petroleum hydrocarbons
LT = less than
MADEP = Massachusetts Department of Environmental Protection
µg/L = micrograms per liter
VPH = volatile petroleum hydrocarbons

TABLE 3-12
REMEDIAL INVESTIGATION GROUNDWATER DATA SUMMARY FOR WATER QUALITY AND BIOREMEDIATION PARAMETERS
SA 61Z

SA 61Z NO FURTHER ACTION DECISION DOCUMENT
DEVENS, MA

	Round 1	Round 2	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Analyte	**61M-96-01X MX6101X1 07/31/96**	**61M-96-01X MD6101X2 10/31/96**	**61M-96-01X MX6101X2 10/31/96**	**61M-96-02X MX6102X1 07/31/96**	**61M-96-02X MX6102X2 11/01/96**	**61M-96-03A MX6103A1 07/31/96**	**61M-96-03A MX6103A2 10/31/96**	**61M-96-03B MX6103B1 07/31/96**	**61M-96-03B MX6103B2 10/31/96**	**B202-3 MX2023X1 07/31/96**	**B202-3 MX2023X2 11/01/96**	**TWP-1 MXTWP1X1 07/31/96**	**TWP-1 MXTWP1X2 10/31/96**
Alkalinity, µg/L	19000	25000	23000	34000	35000	28000	22000	28000	29000	12000	15000	13000	13000
Total Hardness, µg/L	46800	38800	40000	58000	86400	48800	51800	60000	62800	40400	42000	228000	1010000
Chloride, µg/L	18700	6480	6151	92000	88000	28500	25200	56000	56000	4610	2740	19000	28500
Sulfate, µg/L	14000	17000	17000	23000	21000	15000	18000	18000	18000	24000	25000	20000	20000
Total Organic Carbon, µg/L	1040	1650	1700	LT 1000	LT 1000	1270	LT 1000	LT 1000	LT 1000	LT 1000	LT 1000	1030	1160
Iron, Total, µg/L	LT 36.8	NA	NA	LT 36.8	NA	64.8	NA	LT 36.8	NA	LT 36.8	NA	5440	NA
Iron, Dissolved, µg/L	LT 36.8	NA	NA	LT 36.8	NA	LT 36.8	NA	LT 36.8	NA	LT 36.8	NA	5320	NA
Nitrite, Nitrate Non-specific, µg/L	1900	NA	NA	1500	NA	1900	NA	1300	NA	2300	NA	1800	NA
Total Kjeldahl Nitrogen, µg/L	LT 183	NA	NA	238	NA	LT 183	NA	LT 183	NA	LT 183	NA	LT 183	NA
Total Phosphorus, µg/L	LT 13.3	NA	NA	LT 13.3	NA	28.7	NA	LT 13.3	NA	LT 13.3	NA	76.2	NA
Total Sulfide, µg/L	LT 50	NA	NA	LT 50	NA	LT 50	NA	LT 50	NA	LT 50	NA	LT 50	NA
Methane, mg/L	ND	NA	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA
Ethylene, mg/L	ND	NA	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA
Ethane, mg/L	ND	NA	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA
Total Bacteria, CFU/ml	23000	NA	NA	37000	NA	40000	NA	60000	NA	3000J	NA	43000	NA

Notes:
CFU = colony forming units
J = estimated value below detection limit
LT = less than
ml = milliliters
mg/L = milligrams per liter
NA = not analyzed
ND = not detected
µg/L = micrograms per liter

TABLE 4-1
SUMMARY OF GROUNDWATER SAMPLE COLLECTION AND ANALYSIS AT SA 48 AND SA 61Z

SA 61Z NO FURTHER ACTION DECISION DOCUMENT
DEVENS, MA

Monitoring Well	Sampling Event						
	SA 48 SI			Dry Well reMOVAL		SA 61Z RI	
	Round 1	Round 2	SA 48 SSI	Round 1	Round 2	Round 1	Round 1
B202-1	TPH VOCs/SVOCs Inorganics Cations/anions	TPH VOCs/SVOCs Inorganics Explosives Cations/anions	TPH VOCs SVOCs Inorganics Inorganics (Filter)	not sampled	not sampled	not sampled	not sampled
B202-2	TPH VOCs/SVOCs Inorganics Cations/anions	TPH VOCs/SVOCs Inorganics Explosives Cations/anions	TPH VOCs SVOCs Inorganics Inorganics (Filter)	not sampled	not sampled	not sampled	not sampled
B202-3	TPH VOCs/SVOCs Inorganics Cations/anions	TPH VOCs/SVOCs Inorganics Explosives Cations/anions	TPH VOCs SVOCs Inorganics Inorganics (Filter)	not sampled	not sampled	TPH EPH/VPH Water Quality	TPH EPH/VPH Water Quality
48M-93-04X	not installed	not installed	TPH VOCs SVOCs Inorganics Inorganics (Filter)	not sampled	not sampled	not sampled	not sampled
TWP-1	not installed	not installed	not installed	TPH VOCs SVOCs	TPH VOCs SVOCs	TPH EPH/VPH Water Quality	TPH EPH/VPH Water Quality
61Z-96-01X	not installed	not installed	not installed	not installed	not installed	TPH EPH/VPH Water Quality	TPH EPH/VPH Water Quality
61Z-96-02X	not installed	not installed	not installed	not installed	not installed	TPH EPH/VPH Water Quality	TPH EPH/VPH Water Quality
61Z-96-03A	not installed	not installed	not installed	not installed	not installed	TPH EPH/VPH Water Quality	TPH EPH/VPH Water Quality
61Z-96-03B	not installed	not installed	not installed	not installed	not installed	TPH EPH/VPH Water Quality	TPH EPH/VPH Water Quality

CONSENSUS STATEMENT
CLARIFICATION OF STUDY AREA STATUS

between
U.S. Environmental Protection Agency,
Massachusetts Department of Environmental Protection,
and
U.S. Department of the Army

PURPOSE: The purpose of this Consensus Statement is to change the status of Area of Contamination (AOC) 61Z at Devens Reserve Forces Training Area (RFTA) from an AOC to a Study Area (SA).

FINDINGS: On December 21, 1989, Fort Devens was placed on the National Priorities List under the Comprehesive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986, to evaluate, select, and implement response actions to prevent, mitigate, or abate the release of hazardous substances, pollutants, and contaminants at Fort Devens. A Federal Facility Agreement entered into by the U.S. Department of the Army and the U.S. Environmental Protection Agency in 1991, established a procedural framework for ensuring that appropriate response actions are implemented at Fort Devens under CERCLA.

AOC 61Z is the former site of a motor pool at the corner of Carey and St. Mihiel streets on the northeast portion of the Main Post at the Devens RFTA, Devens, Massachusetts. The main feature at the site is Building 202, now abandoned, which was used until the early 1990s as a maintenance and motor repair shop. Liquid wastes generated during maintenance operations at Building 202 were discharged to a drain pit, located in the northeast corner of Building 202, and subsequently to a dry well located between Building 202 and St. Mihiel Street. Building 202 was also the site of a 1,000-gallon waste oil underground storage tank (UST) and a 5,000 gallon No. 2 fuel oil UST. Portions of an unpaved parking lot southeast of Building 202 are presenting being used for the lined and covered temporary storage of contaminated soil removed from other sites at Devens RFTA. The U.S. Army plans to transfer ownership of property at AOC 61Z to the Massachusetts Government Land Bank for commercial development consistent with the Devens Reuse Plan.

The waste oil UST, located along the southeast wall of Building 202, was put in service in 1942. Environmental contamination associated with the waste oil UST was investigated as SA 48. The waste oil UST was removed along with approximately 100 cy of soil in February 1989. Additional soil removal occurred in 1993. Subsequent sampling and a human health Preliminary Risk Evaluation indicated that residual contamination at SA 48 did not pose a risk to human health. A No Further Action Decision Document for SA 48 was completed and signed in 1995.

The dry well at Building 202 and the adjacent unpaved parking lot were investigated in 1994 as Area Requiring Environmental Evaluation (AREE) 61Z. Based on the analytical results for subsurface soil samples collected at the location of the dry well and surface soil samples from the

unpaved parking lot, AREE 61Z was designated AOC 61Z and recommended for remedial investigation (RI). The dry well was removed along with approximately 200 cubic yards (cy) of petroleum-contaminated soil in March 1995. Subsurface soil sampling during the dry well removal show that those activities successfully removed petroleum contaminated soil exceeding the Massachusetts Department of Environment Protection action limit of 500 milligrams per kilogram of total petroleum hydrocarbons (TPH) to a depth of 15 feet below ground surface (bgs). Concentrations of residual petroleum contamination measured as total petroleum hydrocarbons in soil deeper than 15 feet decrease to 248 parts per million (ppm) at 23.5 feet bgs. This removal action significantly reduced the potential for site soils to be a source of groundwater contamination.

RI activities focused on potential groundwater contamination. Groundwater samples collected in August 1996 showed petroleum contamination of up to 6,550 micrograms per liter (µg/L) existed in shallow groundwater downgradient of the former dry well location. Samples collected in November 1996 showed only low concentrations (22 µg/L) of TPH and indicated that groundwater quality had improved significantly. This is attributed to removal of the dry well which was the interpreted contaminant source, to attenuation of fuel compounds in groundwater by sorption and biological degradation, and dispersion and dilution.

A baseline human health risk assessment based on the Massachusetts Contingency Plan Method 3 approach was performed to evaluate potential risks associated with commercial/industrial worker exposure to groundwater contaminated with Extractable and Volatile Petroleum Hydrocarbon fractions (EPH/VPH) of TPH at AOC 61Z. There is no current use of the groundwater at AOC 61Z, and the risk assessment evaluated potential exposure risks to commercial/industrial workers. The estimated noncarcinogenic risks did not exceed a cumulative Hazard Index of 1. Because the EPH/VPH fractions are not established as carcinogenic, there was no identified cancer risk. Further, state and federal drinking water standards were not exceeded, and no risk to public welfare was identified. An environmental risk assessment was not performed because ecological receptors are not likely to be exposed to site groundwater. In summary, the risk assessment demonstrated that no significant risk associated with groundwater exposure exists at the site

The fuel oil UST, located adjacent to the northeast wall of Building 202, was removed in 1996. Screening samples collected from the excavation bottom at approximately 11 feet bgs and sidewalls prior to backfilling showed TPH concentrations of less than 25 ppm.

CONSENSUS: On the basis of these findings, the parties to this Consensus Statement agree to the following:

> Upon consideration of the completed dry well, fuel oil UST, and soil removal actions;the planned commercial reuse of the site; and the conclusion of the baseline risk assessment; there is no reason to conclude that releases from the former dry well at AOC 61Z or the fuel oil UST pose a threat to human health or the environment or that further response action regarding the AOC 61Z dry well or the fuel oil UST is required of the Army.

Further evaluation of surface soil in the unpaved parking lot will be performed by the U.S. Army following removal of stockpiled soil.

The status of AOC 61Z is hereby changed to that of a SA. The U.S. Army will prepare a Site Investigation report to present the results of the RI field work at the site.

The Massachusetts Department of Environmental Protection's execution of this Consensus Statement constitutes its concurrence that further action by the U.S. Army is not required concerning releases from the AOC 61Z dry well and fuel oil UST

Signature below by the U.S. Environmental Protection Agency, Massachusetts Department of Environmental Protection, and U.S. Department of the Army constitutes concurrence with same.

U.S. DEPARTMENT OF THE ARMY

James C. Chambers — 6 JAN 98 (Date)
BRAC Environmental Coordinator
Devens Reserve Forces Training Area
Devens, Massachusetts

U.S. ENVIRONMENTAL PROTECTION AGENCY

James P. Byrne — 1/6/98 (Date)
Fort Devens Remedial Project Manager
U.S. Environmental Protection Agency, New England

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

D. Lynne Welsh — 1/6/98 (Date)
Section Chief, Federal Facilities - CERO
Massachusetts Department of Environmental Protection

SUBSURFACE SOIL AND GROUNDWATER RISK ASSESSMENT TABLES

TABLE B-1
INCIDENTAL INGESTION OF AND DERMAL CONTACT WITH SURFACE SOIL - RME
FUTURE ADULT RESIDENT
SA 61Z
FORT DEVENS, MA

23-Dec-99

August 1992

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	Source
CONCENTRATION SOIL	CS	See Below*	mg/kg	
INGESTION RATE	IR	100	mg/day	USEPA, 1994
FRACTION INGESTED	FI	100%		Assumption
SOIL ADHERENCE FACTOR	SAF	0.08	mg/cm²	USEPA, 1998
SURFACE AREA EXPOSED	SA	5700	cm²	USEPA, 1998
CONVERSION FACTOR	CF	0.000001	kg/mg	kg/mg
BODY WEIGHT	BW	70	kg	USEPA, 1994
EXPOSURE FREQUENCY	EF	150	days/year	USEPA, 1994
EXPOSURE DURATION	ED	24	years	USEPA, 1994
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1994
NONCANCER	AT	24	years	USEPA, 1994
DERMAL ABSORPTION EFFICIENCY	AE	Chemical-specific	unitless	USEPA, 1998 [a]

Notes:
For noncarcinogenic effects: AT = ED

USEPA, 1998 - Human Health Evaluation Manual Supplemental Guidance; Dermal Risk Assessment, NCEA-W-0364. May 7, 1998.
USEPA, 1994 - Risk Updates #2. USEPA Region I. August
[a] ABSd for TPH based on dermal absorption efficiency for PAHs. Dermal RfD calculated using oral absorption efficiency for PAHs. This approach is consistent with MADEP's use of pyrene dose-response data for TPH.

*The maximum detected concentration
ND = Value not determined

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

INTAKE = (INTAKE-INGESTION) + (INTAKE-DERMAL)

$$\text{INTAKE-INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$\text{INTAKE-DERMAL} = \frac{CS \times SA \times SAF \times AE \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

TABLE B-1
INCIDENTAL INGESTION OF AND DERMAL CONTACT WITH SURFACE SOIL - RME
FUTURE ADULT RESIDENT
SA 61Z
FORT DEVENS, MA

CARCINOGENIC EFFECTS

COMPOUND	SOIL CONCENTRATION (mg/kg)	INTAKE INGESTION (mg/kg-day)	DERMAL ABSORPTION EFFICIENCY	INTAKE DERMAL (mg/kg-day)	CANCER SLOPE FACTOR ORAL (mg/kg-day)-1	CANCER SLOPE FACTOR DERMAL (mg/kg-day)-1	CANCER RISK INGESTION	CANCER RISK DERMAL	TOTAL CANCER RISK	PERCENT TOTAL RISK
No potentially carcinogenic COPCs detected										
						SUMMARY CANCER RISK	0E+00	0E+00	0E+00	

NONCARCINOGENIC EFFECTS

COMPOUND	SOIL CONCENTRATION (mg/kg)	INTAKE INGESTION (mg/kg-day)	DERMAL ABSORPTION EFFICIENCY	INTAKE DERMAL (mg/kg-day)	REFERENCE DOSE ORAL (mg/kg-day)	REFERENCE DOSE DERMAL (mg/kg-day)	HAZARD QUOTIENT INGESTION	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT	PERCENT TOTAL RISK
Total Petroleum Hydrocarbons	118	6.9E-05	0.13	4.1E-05	3.0E-02	2.7E-02	2.3E-03	1.5E-03	3.8E-03	100.0%
						SUMMARY HAZARD INDEX	0.002	0.002	0.004	

TABLE B-2
INCIDENTAL INGESTION OF AND DERMAL CONTACT WITH SURFACE SOIL - RME
FUTURE CHILD RESIDENT
SA 61Z
FORT DEVENS, MA

23-Dec-99

August 1992

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	Source
CONCENTRATION SOIL	CS	See Below*	mg/kg	
INGESTION RATE	IR	200	mg/day	USEPA, 1994
FRACTION INGESTED	FI	100%		Assumption
SOIL ADHERENCE FACTOR	SAF	0.3	mg/cm²	USEPA, 1998
SURFACE AREA EXPOSED	SA	2900	cm²	USEPA, 1998
CONVERSION FACTOR	CF	0.000001	kg/mg	kg/mg
BODY WEIGHT	BW	15	kg	USEPA, 1994
EXPOSURE FREQUENCY	EF	150	days/year	USEPA, 1994
EXPOSURE DURATION	ED	6	years	USEPA, 1994
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1994
NONCANCER	AT	6	years	USEPA, 1994
DERMAL ABSORPTION EFFICIENCY	AE	Chemical-specific	unitless	USEPA, 1998 [a]

Notes:
For noncarcinogenic effects: AT = ED

USEPA, 1998 - Human Health Evaluation Manual Supplemental Guidance; Dermal Risk Assessment, NCEA-W-0364. May 7, 1998.
USEPA, 1994 - Risk Updates #2. USEPA Region I. August
[a] ABSd for TPH based on dermal absorption efficiency for PAHs. Dermal RfD calculated using oral absorption efficiency for PAHs. This approach is consistent with MADEP's use of pyrene dose-response data for TPH.

*The maximum detected concentration
ND = Value not determined

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

INTAKE = (INTAKE-INGESTION) + (INTAKE-DERMAL)

$$\text{INTAKE-INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ \text{days/yr}}$$

$$\text{INTAKE-DERMAL} = \frac{CS \times SA \times SAF \times AE \times CF \times EF \times ED}{BW \times AT \times 365\ \text{days/yr}}$$

TABLE B-2
INCIDENTAL INGESTION OF AND DERMAL CONTACT WITH SURFACE SOIL - RME
FUTURE CHILD RESIDENT
SA 61Z
FORT DEVENS, MA

CARCINOGENIC EFFECTS

COMPOUND	SOIL CONCENTRATION (mg/kg)	INTAKE INGESTION (mg/kg-day)	DERMAL ABSORPTION EFFICIENCY	INTAKE DERMAL (mg/kg-day)	CANCER SLOPE FACTOR ORAL (mg/kg-day)-1	CANCER SLOPE FACTOR DERMAL (mg/kg-day)-1	CANCER RISK INGESTION	CANCER RISK DERMAL	TOTAL CANCER RISK	PERCENT TOTAL RISK
No potentially carcinogenic COPCs detected										
						SUMMARY CANCER RISK	0E+00	0E+00	0E+00	

NONCARCINOGENIC EFFECTS

COMPOUND	SOIL CONCENTRATION (mg/kg)	INTAKE INGESTION (mg/kg-day)	DERMAL ABSORPTION EFFICIENCY	INTAKE DERMAL (mg/kg-day)	REFERENCE DOSE ORAL (mg/kg-day)	REFERENCE DOSE DERMAL (mg/kg-day)	HAZARD QUOTIENT INGESTION	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT	PERCENT TOTAL RISK
Total Petroleum Hydrocarbons	118	6.5E-04	0.13	3.7E-04	3.0E-02	2.7E-02	2.2E-02	1.4E-02	3.5E-02	100.0%
						SUMMARY HAZARD INDEX	0.02	0.01	0.04	

TABLE B-3
INHALATION EXPOSURE TO PARTICULATES IN SURFACE SOIL - RME
FUTURE ADULT RESIDENT
SA 61Z
FORT DEVENS, MA

23-Dec-99

August 1992

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS
CONCENTRATION SOIL*	CS	See below	mg/kg
CONCENTRATION AIR PARTICULATES	CAp	Calculated	mg/m³
CONCENTRATION AIR VOLATILES	CAv	Calculated	mg/m³
VOLATILIZATION FACTOR**	VF	Calculated	m³/kg
PARTICULATE EMISSIONS FACTOR	PEF	1.32E+09	ug/m³
INHALATION RATE	IhR	0.83	m³/hour
BODY WEIGHT	BW	70	kg
EXPOSURE TIME	ET	24	hours/day
EXPOSURE FREQUENCY	EF	150	days/year
EXPOSURE DURATION	ED	24	years
RELATIVE ABSORPTION FACTOR	RAF	100%	
AVERAGING TIME			
CANCER	AT	70	years
NONCANCER	AT	24	years

Notes: * Soil concentration used is the lesser of the 95 % upper confidence limit (UCL) & maximum concentration
**Volatilization factor used only for volatile chemicals of potential concern.
For noncarcinogenic effects: AT = ED
ND = Value not determined

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE CONCENTRATION (mg/kg-day)

$$\text{INTAKE - INHALATION} = \frac{(CAp + Cav) \times RAF \times IhR \times ET \times EF \times ED}{BW \times AT \times 365 \text{ days/yr}}$$

AIR CONCENTRATION PARTICULATES = CS x 1/PEF

AIR CONCENTRATION VOLATILES = CS x 1/VF
(VF not calculated because there are no VOCs selected as CPCs).

TABLE B-3
INHALATION EXPOSURE TO PARTICULATES IN SURFACE SOIL - RME
FUTURE ADULT RESIDENT
SA 61Z
FORT DEVENS, MA

CARCINOGENIC EFFECTS

COMPOUND	SOIL CONCENTRATION (mg/kg)	VF (m^3/kg)	AIR CONCENTRATION VOLATILES (mg/m^3)	AIR CONCENTRATION PARTICULATES (mg/m^3)	INTAKE (mg/kg-day)	CANCER SLOPE FACTOR (mg/kg-day)-1	CANCER RISK	PERCENT TOTAL RISK
No potentially carcinogenic COPCs detected								
						SUMMARY CANCER RISK	0E+00	

NONCARCINOGENIC EFFECTS

COMPOUND	SOIL CONCENTRATION (mg/kg)	VF (m^3/kg)	AIR CONCENTRATION VOLATILES (mg/m^3)	AIR CONCENTRATION PARTICULATES (mg/m^3)	INTAKE (mg/kg-day)	REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT	PERCENT TOTAL RISK
OTHER								
Total Petroleum Hydrocarbons	118	NA		8.9E-08	1.0E-08	8.5E-04	1.2E-05	100.0%
						SUMMARY HAZARD INDEX	0.00001	

TABLE B-4
INHALATION EXPOSURE TO PARTICULATES IN SURFACE SOIL - RME
FUTURE CHILD RESIDENT
SA 61Z
FORT DEVENS, MA

23-Dec-99

August 1992

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS
CONCENTRATION SOIL*	CS	See below	mg/kg
CONCENTRATION AIR PARTICULATES	CAp	Calculated	mg/m³
CONCENTRATION AIR VOLATILES	CAv	Calculated	mg/m³
VOLATILIZATION FACTOR**	VF	Calculated	m³/kg
PARTICULATE EMISSIONS FACTOR	PEF	1.32E+09	ug/m³
INHALATION RATE	IhR	0.625	m³/hour
BODY WEIGHT	BW	15	kg
EXPOSURE TIME	ET	24	hours/day
EXPOSURE FREQUENCY	EF	150	days/year
EXPOSURE DURATION	ED	6	years
RELATIVE ABSORPTION FACTOR	RAF	100%	
AVERAGING TIME			
CANCER	AT	70	years
NONCANCER	AT	6	years

Notes: * Soil concentration used is the lesser of the 95 % upper confidence limit (UCL) & maximum concentration
**Volatilization factor used only for volatile chemicals of potential concern.
For noncarcinogenic effects: AT = ED
ND = Value not determined

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE CONCENTRATION (mg/kg-day)

$$\text{INTAKE - INHALATION} = \frac{(CAp + Cav) \times RAF \times IhR \times ET \times EF \times ED}{BW \times AT \times 365 \text{ days/yr}}$$

AIR CONCENTRATION PARTICULATES = CS x 1/PEF

AIR CONCENTRATION VOLATILES = CS x 1/VF
(VF not calculated because there are no VOCs selected as CPCs).

TABLE B-4
INHALATION EXPOSURE TO PARTICULATES IN SURFACE SOIL - RME
FUTURE CHILD RESIDENT
SA 61Z
FORT DEVENS, MA

CARCINOGENIC EFFECTS

COMPOUND	SOIL CONCENTRATION (mg/kg)	VF (m^3/kg)	AIR CONCENTRATION VOLATILES (mg/m^3)	AIR CONCENTRATION PARTICULATES (mg/m^3)	INTAKE (mg/kg-day)	CANCER SLOPE FACTOR (mg/kg-day)-1	CANCER RISK	PERCENT TOTAL RISK
No potentially carcinogenic COPCs detected								
						SUMMARY CANCER RISK	0E+00	

NONCARCINOGENIC EFFECTS

COMPOUND	SOIL CONCENTRATION (mg/kg)	VF (m^3/kg)	AIR CONCENTRATION VOLATILES (mg/m^3)	AIR CONCENTRATION PARTICULATES (mg/m^3)	INTAKE (mg/kg-day)	REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT	PERCENT TOTAL RISK
OTHER								
Total Petroleum Hydrocarbons	118	NA		8.9E-08	3.7E-08	8.5E-04	4.3E-05	100.0%
						SUMMARY HAZARD INDEX	0.00004	

GWCR
INGESTION OF AND DIRECT CONTACT WITH GROUND WATER - WELL TWP-1
CHILD RESIDENT (AGES 1-5)
SA 61Z DECISION DOCUMENT
DEVENS, MA
TABLE B-5

23-Dec-99

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
Concentration in Ground Water	OHMgw		mg/liter	Site-specific
Lifetime Average Daily Dose	LADD	calculated below		MADEP, 1995
Average Daily Dose	ADD	calculated below		MADEP, 1995
Ingestion Rate	IR	1	liters/day	MADEP, 1995
Surface Area Exposed	SA	6,642	cm^2	MADEP, 1995
Body Weight	BW	15	kg	MADEP, 1995
Conversion Factor	CF	0.001	$liter/cm^3$	
Exposure Time	ED	0.2	hours/day	
Exposure Frequency	EF	350	days/year	MADEP, 1995
Exposure Period	EP	5	years	MADEP, 1995
Averaging Time				
Cancer	ATc	75	years	MADEP, 1995
Noncancer	ATn	5	years	MADEP, 1995
Relative Absorption Factor (RAF)				
Oral	RAFo	listed below	unitless	MADEP, 1995
Dermal	RAFd	listed below	unitless	MADEP, 1995
Permeability Constant	Kp	listed below	cm/hour	MADEP, 1995

MADEP, 1995 "Guidance for Disposal Site Risk Characterization"

EQUATIONS

CANCER RISK = LADD (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1

HAZARD QUOTIENT = ADD (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{LADD-INGESTION} = \frac{\text{OHMgw x IR x RAFi x EF x EP}}{\text{BW x ATc x 365 days/yr}}$$

$$\text{ADD-INGESTION} = \frac{\text{OHMgw x IR x RAFi x EF x EP}}{\text{BW x ATn x 365 days/yr}}$$

$$\text{LADD-DERMAL} = \frac{\text{OHMgw x SA x Kp x RAFd x CF x ED x EF x EP}}{\text{BW x ATc x 365 days/yr}}$$

$$\text{ADD-DERMAL} = \frac{\text{OHMgw x SA x Kp x RAFd x CF x ED x EF x EP}}{\text{BW x ATn x 365 days/yr}}$$

Note:
For noncarcinogenic risk, AT = EP

GWCR
INGESTION OF AND DIRECT CONTACT WITH GROUND WATER - WELL TWP-1
CHILD RESIDENT (AGES 1-5)
SA 61Z DECISION DOCUMENT
DEVENS, MA
TABLE B-5

23-Dec-99

CARCINOGENIC EFFECTS

OHM	WATER CONCENTRATION (mg/l)	ORAL RAF	INTAKE INGESTION (mg/kg-day)	Kp (cm/hr)	DERMAL RAF	INTAKE DERMAL (mg/kg-day)	CANCER SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK INGESTION	CANCER RISK DERMAL	TOTAL CANCER RISK
No carcinogenic COCs										
SUMMARY CANCER RISK								0E+00	0E+00	0E+00

NONCARCINOGENIC EFFECTS

OHM	WATER CONCENTRATION (mg/l)	ORAL RAF	INTAKE INGESTION (mg/kg-day)	Kp (cm/hr)	DERMAL RAF	INTAKE DERMAL (mg/kg-day)	REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT INGESTION	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
C5 to C8 Aliphatics	0.0055	1	3.5E-04	0.324	1	1.5E-04	0.06	5.9E-03	2.5E-03	8.4E-03
C9 to C18 Aliphatics	0.283	1	1.8E-02	0.324	1	7.8E-03	0.6	3.0E-02	1.3E-02	4.3E-02
C19 to C36 Aliphatics	2.502	1	1.6E-01	0.324	1	6.9E-02	6	2.7E-02	1.1E-02	3.8E-02
C10 to C22 Aromatics	0.498	0.91	2.9E-02	0.324	0.04	5.5E-04	0.03	9.7E-01	1.8E-02	9.8E-01
SUMMARY HAZARD INDEX								1	0.05	1

Pyrene Kp used as a surrogate for all COCs.

GWAR
INGESTION OF AND DIRECT CONTACT WITH GROUND WATER - WELL TWP-1
ADULT RESIDENT (AGES 5-31)
SA 61Z DECISION DOCUMENT
DEVENS, MA
TABLE B-6

23-Dec-99

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
Concentration in Ground Water	OHMgw		mg/liter	Site-specific
Lifetime Average Daily Dose	LADD	calculated below		MADEP, 1995
Average Daily Dose	ADD	calculated below		MADEP, 1995
Ingestion Rate	IR	2	liters/day	MADEP, 1995
Surface Area Exposed	SA	16,473	cm^2	MADEP, 1995
Body Weight	BW	70	kg	MADEP, 1995
Conversion Factor	CF	0.001	$liter/cm^3$	
Exposure Time	ED	0.2	hours/day	
Exposure Frequency	EF	350	days/year	MADEP, 1995
Exposure Period	EP	25	years	MADEP, 1995
Averaging Time				
Cancer	ATc	75	years	MADEP, 1995
Noncancer	ATn	25	years	MADEP, 1995
Relative Absorption Factor (RAF)				
Oral	RAFo	listed below	unitless	MADEP, 1995
Dermal	RAFd	listed below	unitless	MADEP, 1995
Permeability Constant	Kp	listed below	cm/hour	MADEP, 1995

MADEP, 1995 "Guidance for Disposal Site Risk Characterization"

EQUATIONS

CANCER RISK = LADD (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1›

HAZARD QUOTIENT = ADD (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{LADD-INGESTION} = \frac{OHMgw \times IR \times RAFi \times EF \times EP}{BW \times ATc \times 365\ days/yr}$$

$$\text{ADD-INGESTION} = \frac{OHMgw \times IR \times RAFi \times EF \times EP}{BW \times ATn \times 365\ days/yr}$$

$$\text{LADD-DERMAL} = \frac{OHMgw \times SA \times Kp \times RAFd \times CF \times ED \times EF \times EP}{BW \times ATc \times 365\ days/yr}$$

$$\text{ADD-DERMAL} = \frac{OHMgw \times SA \times Kp \times RAFd \times CF \times ED \times EF \times EP}{BW \times ATn \times 365\ days/yr}$$

Note:
For noncarcinogenic risk, AT = EP

GWAR
INGESTION OF AND DIRECT CONTACT WITH GROUND WATER - WELL TWP-1
ADULT RESIDENT (AGES 5-31)
SA 61Z DECISION DOCUMENT
DEVENS, MA
TABLE B-6

23-Dec-99

CARCINOGENIC EFFECTS

OHM	WATER CONCENTRATION (mg/l)	ORAL RAF	INTAKE INGESTION (mg/kg-day)	Kp (cm/hr)	DERMAL RAF	INTAKE DERMAL (mg/kg-day)	CANCER SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK INGESTION	CANCER RISK DERMAL	TOTAL CANCER RISK
							SUMMARY CANCER RISK	0E+00	0E+00	0E+00

NONCARCINOGENIC EFFECTS

OHM	WATER CONCENTRATION (mg/l)	ORAL RAF	INTAKE INGESTION (mg/kg-day)	Kp (cm/hr)	DERMAL RAF	INTAKE DERMAL (mg/kg-day)	REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT INGESTION	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
C5 to C8 Aliphatics	0.0055	1	1.5E-04	0.324	1	8.0E-05	0.06	2.5E-03	1.3E-03	3.9E-03
C9 to C18 Aliphatics	0.283	1	7.8E-03	0.324	1	4.1E-03	0.6	1.3E-02	6.9E-03	2.0E-02
C19 to C36 Aliphatics	2.502	1	6.9E-02	0.324	1	3.7E-02	6	1.1E-02	6.1E-03	1.8E-02
C10 to C22 Aromatics	0.498	0.91	1.2E-02	0.324	0.04	2.9E-04	0.03	4.1E-01	9.7E-03	4.2E-01
							SUMMARY HAZARD INDEX	0.4	0.02	0.5

Pyrene Kp used as a surrogate for all COCs.